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Cash in the Bank

Any owner of a small foundry who is familiar with the contents of the FOUNDRY TRADE JOURNAL over a long period might gain the impression that, so long as his costing system was satisfactory, he could sleep peacefully. If we have given that impression, we now realise our mistake, for we have just read a book called "Financial Control for the Small Manufacturer,"* by Francis Simmonds, therein, it was quickly impressed upon us that the first worry of the modest manufacturer is his cash position. This must be sufficiently liquid to pay wages and meet his commitments. Yet, even this feature is complicated by the fact that a falling-off in business may, owing to the non-replacement of stocks, provide abundant cash. Conversely, increased business may, because of the purchase of larger stocks and an increased labour force, result in a smaller cash balance. "An expanding business does not make more money available, it requires more cash to be put into it." This book is based on the steps to be taken to ensure that the true cash position or liquidity is kept under control. Wisely, it is pointed out that it is poor business to wait until the cash situation is desperate before interviewing the bank manager, because cash is not the sole yardstick of solvency. Stocks are equally valuable.

Logically, step by step, this book shows how, by a proper long-term examination of his business data, the manufacturer can pretty accurately assess his prospects. Moreover, everything the author writes is so simple that anybody with a knowledge of arithmetic can follow his argument. Among the warnings given are the futility of using the allowances made by the Inspector of Taxes for depreciation, because they are patently inadequate, and the serious impact of overheads on potential profits when a shop is full or half full. One piece of advice given is to take advantage of 2½ per cent. discount, where it is offered, if an account is paid within 7 days, as against net at 30 days. All this leads up to budgetary control set out in Part II of the book. This is a natural outcome of the matter raised earlier, yet once the first seven chapters are assimilated it may be that, for the smaller man, mental arithmetic will keep him on the rails, for he will at least realise the essentials to keep his bank-balance straight. He will have learnt to ascertain whether he can or cannot afford to buy that new piece of plant he fancies. Here it is germane to point out that proper costing is stressed in this section.

We read this book on the day the Government announced its cuts, and received the impression that, had the various chancellors of the exchequer mastered its contents some five years ago, this country would not be in the position in which it finds itself to-day. As small foundry owners have no desire to emulate the Government, we strongly recommend them to study carefully this essentially sensible and simple text-book, which as a subtitle might carry a variation of the old adage "look after the cash position and the business will look after itself."

*To be published on November 11 by Jordan & Sons, Limited, 116, Chancery Lane, London, W.C.2. Price 15s. net.

Contents

Cash in the Bank, 535.—Book Review, 535.—John Summers' Record Output, 536.—Forthcoming Events, 536.—Forty Years Ago, 536.—Pattern Jigging on Moulding Machines, 537.—Melting Equipment, 543.—Annual Report, 1948-49, 546.—Sales and Technical Congress, 550.—Vitreous Enamelling: Furnace Atmospheres in Vitreous Enamelling, 551.—Low-temperature Enamels, 556.—I.V.E. Conference Discussion—Light Castings for Vitreous Enamelling, 556.—Notes from the Branches, 557.—The Managerial Jewel, 557.—Foremen's Mutual Benefit Society, 557.—News in Brief, 558.—Obituary, 558.—Wills, 558.—What is a Kibble?, 558.—£3,000 Scholarship, 558.—Company Results, 559.—Personal, 559.—Company News, 559.—Imports and Exports of Iron and Steel, 560.—Raw Material Markets, 562.

Book Review

Steel and Britain's Future. Published as a Special Issue by the "Iron and Coal Trades Review," 49, Wellington Street, London, W.C.2. Price 5s.

No better time could have been chosen for the publication of this book than the present, because iron and steel are likely to become major topics in the forthcoming general elections. It is not a statistical review—such matter is readily available from other sources—it is factual. The system that has been followed is designed to give the reader a logical appreciation of exactly what has been done in the past, the position now attained, and, by rational extrapolation, the future. Thus, the first article by Sir Ellis Hunter discloses the admittedly complex structure of the industry. Then Professor J. Harry Jones reviews the history of the industry from the introduction of mild steel up to modern times. Next, Sir Walter Benton Jones, Bt., makes a particularly-interesting survey of the fundamental elements of steelmaking. He points to such factors as the use of small boats to bring iron ore into this country and return with cargoes of coal, This no longer functions, the lack of a return load having a nefarious impact on the economy of iron and steel making. Technology now comes into the picture, with an authoritative article on the layout of integrated iron and steel works, by H. H. Mardon and J. S. Terrington, of the British Iron and Steel Research Association. The politicians will, or should, appreciate the article on the Steel Development Plan, by Robert Shone, for it outlines the great benefits obtained by co-operation with the Government rather than domination by the proposed State monopoly. To prove that the steel plan is not just "talk," there are 22 articles which detail the progress made by a like number of separate concerns. The balance of the book covers such subjects as research (by Sir Charles Goodeve); trends (by Sir Andrew McCance); the relationship of steel to other industries; accident prevention; youth recruitment, training and welfare. Each subject has been dealt with by an acknowledged authority. Whether the iron and steel industry is efficient or not can be left to the judgment of the reader, but there can be no question that, as a review of the existing state of the iron and steel industry, this book is easily the best ever made available. It runs to 250 pages and is profusely illustrated. Foundrymen, who should know something about their sister industry, are strongly advised to acquire a copy. They will find it so much more satisfactory than a study of the report of the groundnuts scheme.

John Summers' Record Output

In the week ended October 22 production of steel ingots at the Hawarden Bridge Works, Shotton, Chester, of John Summers & Sons, Limited, was at the all-time record level of 11,192 tons. At the Stoke Works of its subsidiary company, the Shelton Iron, Steel & Coal Company, Limited, there was also a record production return of 5,484 tons.

Forthcoming Events

NOVEMBER 7.

Institute of British Foundrymen.

Sheffield Branch :—"Incentives for the Future," by J. G. Bailes, at the Royal Victoria Station Hotel, Sheffield, at 7.30 p.m.

Institution of Production Engineers.

Halifax Section :—"Efficient Production Methods Applied to Iron Founding," by G. W. Nicholls, A.M.I.P.E., M.I.B.F., at Whiteley's Café, Westgate, Huddersfield, at 7.15 p.m. p.m.

Manchester Graduate Section :—"Mechanised Foundries," by Fox, at the College of Technology, Sackville Street, Manchester, at 7.15 p.m.

NOVEMBER 8.

Institute of British Foundrymen.

Coventry Students' Section :—"The Patternmaker and Foundryman as a Team," by E. R. Pearson, at Coventry Technical College, at 7.15 p.m.

East Anglian Section :—"The Production of Internal Combustion Engine Castings," by C. R. van der Ben, at the Central Hall, Public Library, Ipswich, at 7 p.m.

NOVEMBER 9.

Lancashire Branch :—"Patternmaking as an Aid to Production Moulding and Core Blowing," by S. A. Horton, at the Engineers' Club, Albert Square, Manchester, at 7 p.m.

Birmingham Students' Section :—Works Visit to Parkinson's Stove Company, Limited, Birmingham, at 2.30 p.m.

NOVEMBER 10.

Lincoln Branch :—"Mechanisation," by J. Hill, at the Lincoln Technical College, at 7.15 p.m.

NOVEMBER 11.

Institution of Production Engineers.

Coventry Section :—"Industrial Maintenance of Machines," by R. M. Buckle, M.I.P.E., at the Greyfriars Rooms, The Geisha Café, Hertford Street, Coventry, at 7 p.m.

NOVEMBER 12.

Institute of British Foundrymen.

Scottish Branch :—"The Loam Moulding of an Evaporator Body Casting," by W. H. Hornby, at the Royal Technical College, Glasgow, at 3 p.m.

Newcastle-upon-Tyne Branch :—Meeting at the Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6 p.m.

Institution of Production Engineers.

Manchester Graduate Section :—Works Visit to Howard & Bullough, Limited, Accrington, at 10 a.m.

Forty Years Ago

Our issue of November, 1909, contains a leader describing the progress being made throughout the world in the use of steel mixes in cupola operations—a practice which received much momentum during the 1914 war. There is a lengthy abstract of the original Paper on the growth of cast irons after repeated heatings by Rugan and Carpenter.

The Presidential Address to the Birmingham Branch of the British Foundrymen's Association by Mr. R. Mason, who only recently died in Australia, contained the germs of the Garrett report. Washing facilities, tidyness and the like were all stressed. Among the commercial news is a note to the effect that the Dover Engineering Works, Limited, had acquired the Dover Iron Foundry, Bridge Street, from A. L. Taylor & Sons, Limited.

Pattern Jigging on Moulding Machines

*By H. Haynes**

In foundries to-day, many types and sizes of moulding machines are in operation, from the old hand-lever-operated snap-flask machine to the modern electrically-operated press-button-type machine. Between these are many more types, for example, the comparatively-old, compressed-air-operated straight-jolt machine, from which the rammed box, with the pattern plate attached, has to be lifted off the machine and turned over on the floor before the pattern can be withdrawn from the mould. A more recent development of this latter machine embodies either roll-over mechanism, lifting levers or arms which turn the box and pattern plate over, and incorporates a vibrator which loosens the pattern, the mould being withdrawn from under the pattern plate. It will be appreciated that there are great differences in the installation, maintenance, and subsequent operational costs of the types of machines mentioned.

Choice of Machine

Very often capital outlay will determine the type of machine chosen for an installation and, again, the quantity of castings ordered, plus the actual varieties of castings, which are required to be made in a day on any one machine, are also determining factors in the choice of machine to be installed. Foundries where a small variety of castings is produced have a fairly easy choice, and large quantities of castings can be obtained by the adoption of the continuous-casting method, but where, as in the Author's case, a great variety of castings must be made in one day from the same machine, the problem is not quite so simple. Batch moulding has to be resorted to, and this entails constant changing and re-setting of patterns on the machine. The time taken to do this operation is one of vital importance, if the production rate of each machine is to be maintained at the highest possible level. The solution of this problem of pattern setting and changing was therefore given priority by the Author when the machines were installed, and he devised a method of jigging on the two types of machine in use, the result being that patterns can now be changed and replaced in a fraction of the time taken when the machines were first installed. The following notes on the methods employed are presented with the hope that they may be of general interest to all and that some will be able to find a practical application of some of the ideas put forward. For it is only by *results* that one can determine the success or failure of the methods employed in attempts to solve the many and varied problems which from day to day confront foundrymen.

The first machine to be described is a jolt-squeeze roll-over type, which is operated by compressed air. These machines have been fitted with extended pattern-supporting tables to enable them to accommodate two pattern boards at the same time, so that top and bottom parts of the same mould may be rammed simultaneously. The extended pattern-supporting plate has a dovetail slide mounted upon it. This dovetail slide is 3 ft. long and 9 in. wide at one end, tapering to 7 in. wide at the other, and is 1½ in. thick before being machined. This cast-iron dovetail slide is fastened down on the machine table with eight ¾-in. dia. tapped set-screws, countersunk level with the face of the slide.

The two rectangular slots shown in Fig. 1 are to accommodate the pins of various sizes of box parts when top and bottom halves of moulds are rammed simultaneously. The six centre holes in the dovetail slide are pin-location holes for use when various sizes of boxes are rammed singly. These box sizes are 20 in. by 16 in. by 6 in., 24 in. by 16 in. by 6 in., and 30 in.

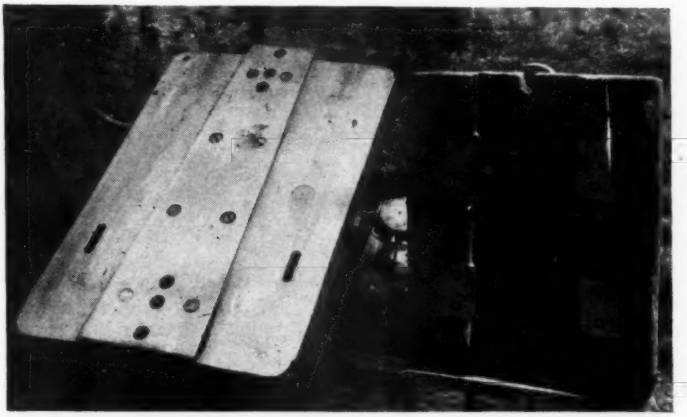

FIG. 1.—(LEFT): PATTERN-SUPPORTING TABLE WITH TAPERING DOVETAIL SLOTS. (RIGHT): MASTER-PLATE JIG BEARING CAST-IRON INSERTS TO FIT INTO THE SLOTS ON THE PLATE.

* National Gas & Oil Engine Company, Limited.

Pattern Jigging on Moulding Machines

by 20 in. by 6 in. Fig. 1 also shows, on the right-hand side, a view of the master plate, which is a wooden board, on one side of which are four cast-iron dovetails machined to fit the dovetail on the extended pattern-supporting plate, each of which measures 4 in. by 4 in. The board slides into position on the table in a few seconds. The assembly is shown in position on the machine in Fig. 2.

On the reverse side of the master plate is the jig, which consists of a cast-iron frame 2 in. wide and 1½ in. thick, accurately machined all over to take the pattern boards. It will be seen in Fig. 3 that one corner of the recess in each master-plate jig is cut off. This makes certain that every pattern board is inserted in its recess in the jig correctly. Each pattern board is held in the recess by four ¾-in. dia. set-screws, and it is a matter of a few seconds only to remove one pattern board from the jig and replace it by another. The master plate is fitted with two correctly-spaced pins opposite one pattern-board recess and with two holes opposite the other recess in order to accommodate the top- and bottom-half moulding boxes respectively. When in position, and secured in its recess, the joint face of the pattern board is $\frac{1}{32}$ in. lower than the face of the master plate jig. It will be appreciated that this forms a sand joint on each half of the mould, which, when the two halves are assembled ready for casting, produces a sand joint $\frac{1}{32}$ in. deep between the top and bottom halves of the mould. This greatly minimises the risk of run-outs when casting, and also eliminates finning on the joints of the castings. Fig. 3 shows just a few of the many varieties of patterns used. There are approximately 500 pattern boards in service.

FIG. 2.—PATTERN-SUPPORTING TABLE, MASTER-PLATE JIG AND PATTERNS MOUNTED ON A MOULDING MACHINE.

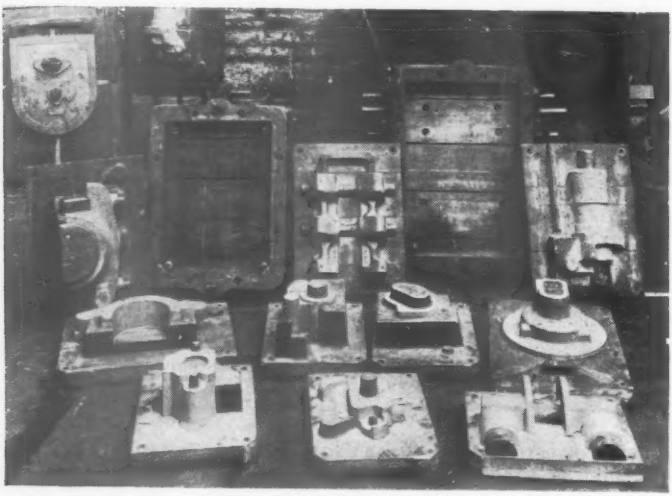

FIG. 3.—GROUP OF MASTER-PLATE JIG FRAMES AND MOUNTED PATTERNS.

FIG. 4.—THREE SIZES OF MASTER-PLATE JIGS WITH PATTERNS IN POSITION.

Fig 4 shows three sizes of master-plate jigs used on this machine and also shows the pattern boards assembled in the jig. The four set-screws previously mentioned can be clearly seen at the corners of each pattern board. These screws are located in brass ferrules on the underside of the master plate. It will also be noticed that small- and medium-size jigs are secured to the master-plate board by eight recessed screws, and the largest-size jig by 10 screws. At this point it is as well to note that, when the moulding box is placed in position over the pattern board, its joint edge rests not on the pattern board itself, but on the face of the jig.

The master plate on the left side of Fig. 4 shows two pattern boards secured inside the jig. The top half of this jig is equipped with two pins and the lower half with two holes for the correct location of the snugs and pins for the top and bottom halves of the same mould. This jig differs from the other two shown in the illustration, because it has a dividing rib across its centre which thus forms two recesses instead of the single recesses of the other two jigs. It will be noticed that the jig in the centre clearly illustrates the difference in level between the pattern board and jig surfaces. The master plate on the right contains a half-pattern for a mould which is turned on end to be cast. These jigs can take

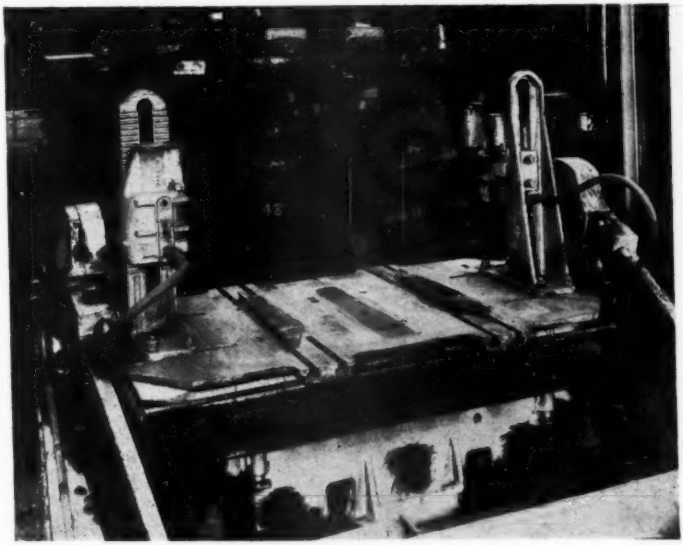

FIG. 5.—TABLE OF THE LARGER ROLL-OVER MACHINE WITH SPACED CAST-IRON DOVETAIL PIECES IN POSITION.

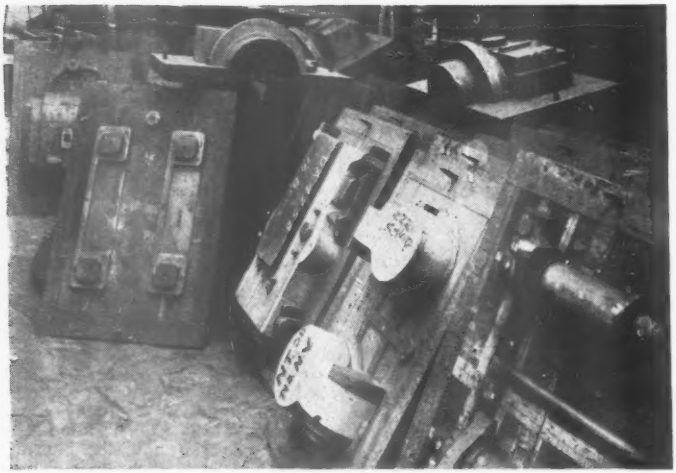

FIG. 6.—GROUP OF PATTERN BOARDS FOR THE LARGER MACHINES.

either wooden or metal patterns and any number of patterns, according to size; from one to, say, 16 can be mounted. The pattern boards are made from two thicknesses of wood screwed over each other cross-grained to counteract shrinkage.

For the Pneulec machine, the dovetail slide is also used to locate pattern boards. This is a larger type of machine than the one previously described, having a lifting capacity of 2,000 to 4,000 lb. This dovetail holds the pattern board in correct position on the machine table during ramming, roll-over, and pattern-drawing operations, and the next photograph (Fig. 5) shows a view of the machine table. It will be noticed here that the two cast-iron pieces, which constitute the dovetail slide, are secured to the machine table, the tee-head bolt slots no longer being used. The taper on this slide amounts to 2 in. (*i.e.*, 21 in. to 23 in. across). The slide consists of two separate cast-iron pieces, each of which is secured to the machine table by two countersunk screws. In the background (Fig. 5) may be seen a

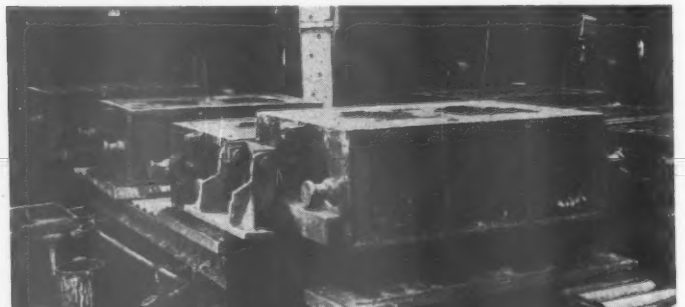

FIG. 7.—MOULDING BOXES LEAVING THE MOULDING MACHINE. IN THE FOREGROUND IS SHOWN A LIFTING JACK FOR REMOVING THE MOULD BOARDS.

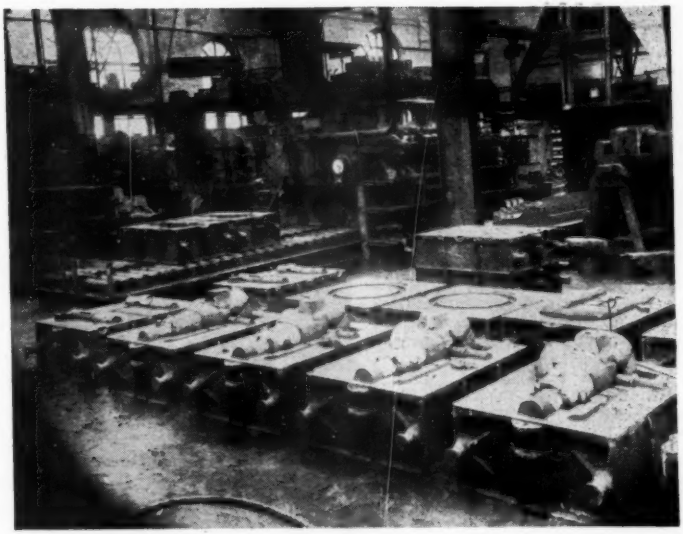

FIG. 8.—TYPICAL MOULDS AFTER CORING-UP. IN THE BACKGROUND IS THE TUNNEL DRYING OVEN.

number of pattern boards and the end of the reverse dovetail which engages the one on the machine table (*i.e.*, to the right of the letter M and of the number 48).

Arrangements for Larger Moulds

In Fig. 6 are shown several pattern boards for the larger machines and it will be noticed that each is fitted with two correctly-spaced pins, for this machine uses boxes having loose pins, with double box snugs at each end to obviate any twist between top and bottom halves of a mould. The loose pins are of standard size and only a few thousandths of an inch clearance is allowed between the pins and snug-holes. Fig. 7 shows the moulding boxes, which are interchangeable as regards top or bottom, and here they are seen leaving the machine along the roller conveyor which leads them directly into a tunnel-type drying stove. Here, also, can be seen a lifting jack which is compressed-air operated by means of a lever on the air pipe (at the left-hand side of the illustration). The jack consists of a cylinder and piston equipped with girder-section lifting arms which automatically locate with the swivels at each end of the moulding boxes. The use of this jack enables the bottom boards to be withdrawn from under the boxes without having to wait for the crane. After the board has been withdrawn, the box is lowered on to the rollers again, and it can then be pushed along the rollers directly into the tunnel stove which is opposite the rollers.

Drying

The half-moulds on the roller conveyor as they leave the tunnel stove after drying are shown in Fig. 8, and also a number of moulds cored up and ready for closing. Here can clearly be seen the double snug at the end of each box part, and it will be noted that the loose pins used for closing these boxes are thus engaged by four holes. This eliminates the possibility of producing castings with twisted or lapped joints. Fig. 9 shows a

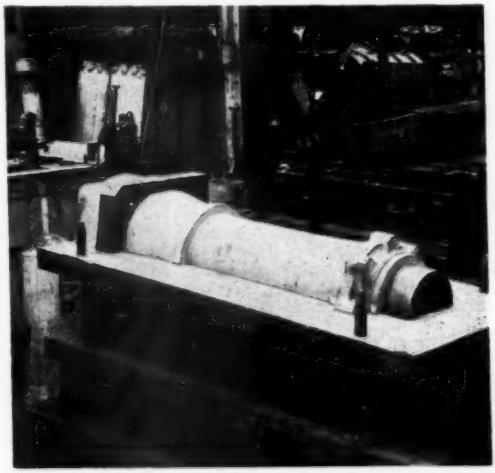

FIG. 9.—LARGE-SIZE PATTERN BOARD WITH FOUR PINS.

Pattern Jigging

FIG. 10.—JOLT-SQUEEZE ROLL-OVER MOULDING MACHINE WITH GROUPS OF MOULDS MADE ON IT.

larger-size pattern board with four pins instead of two, and utilising a different type of moulding box on a bigger machine. Here again the dovetail slide is used for the location of the pattern board on the machine table. At the rear right-hand side can be seen a box filled with sand in the ramming position on the machine.

The final illustrations (Figs. 10 and 11) show how the system of interchangeable patterns on jig plates can be used for mixed production. In Fig. 10 is shown a jolt-squeeze roll-over moulding machine with a jig and pattern assembled on its dovetail plate. Near the machine is a second pattern plate and its jig. The rows of completed moulds are from several different patterns mounted in turn for the day's production; various sizes of moulding box are used if required to suit the different patterns. The final illustration (Fig. 11) shows groups of moulds made on a similar principle, but of a larger type; some are partly cored. Three types of cylinder head are included and the fact that moulds, requiring, as they do, extreme accuracy in production, are made by the "jigging" method is noteworthy testimony to the success of the procedure. An additional point of interest is that the oil-sand cores for these jobs are made from reclaimed sand. They comprise, mainly, jacket cores around a central core.

MR. F. D. MATTHEWS, a director of the Aluminium Bronze Casting Company (Balham), Limited, died yesterday morning after a short illness; he was 72. In recent years Mr. Matthews has withdrawn from active participation in the business, being succeeded by his son, Mr. A. A. Matthews.

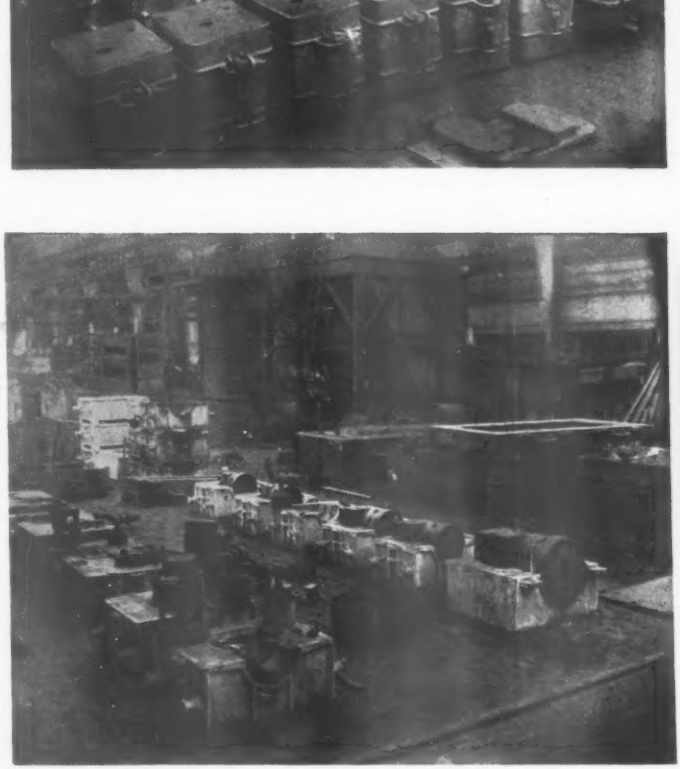

FIG. 11.—LARGER MOULDS, MAINLY FOR CYLINDER HEADS, SHOWING THE INTRICACY OF THE JOBS.

Guide to Aluminium Founding II

Melting Equipment

Merits of Various Furnace Types

By A. W. Brace, A.I.M.

(*Continued from page* 495.)

Aluminium alloys possess common characteristics which determine the equipment and technique used for melting. The casting temperature of these alloys is mainly between 700 and 750 deg. C., and their melting temperature 600 to 650 deg. C. In the molten condition an oxide film is formed on the surface which helps to prevent gas absorption and further oxidation. Nevertheless, all aluminium alloys on occasions exhibit pinhole porosity to a greater or lesser degree. This porosity is due to the fact that gas, mainly hydrogen, is more soluble in liquid than solid aluminium, and the gas thus released during the solidification period is retained as small entrapped bubbles. If the metal is heated over 800 deg. C. or held at a temperature over 750 deg. C. for any appreciable period, grain coarsening results. This "stewing" will also cause excessive oxidation as will also any disturbance of the surface.

Melting equipment must be designed to prevent the combustion products from having ready access to the molten metal, to ensure adequate temperature control and to avoid a large surface of exposed metal. Many furnaces adequately fulfil these requirements.

FIG. 1.—MORGAN COKE-FIRED LIFT-OUT CRUCIBLE FURNACE, 60 LB. CAPACITY.

Coke-fired Furnaces

The choice of a suitable fuel is largely a question of local economies. Coke found favour in the early days, but is not so widely used now. It is rather bulky in relation to calorific value[1] for economical storing, and it must be dry if hydrogen absorption by the melt is to be avoided. Reasonable drying can be achieved by leaving the coke in a bin close to the melting furnace for several days. To preserve the crucible, the coke should be packed uniformly around it, thus avoiding uneven heating. Temperature control of coke-fired furnaces is not good and much depends upon the skill of the furnaceman in knowing the behaviour of the furnace. Coke furnaces, a typical example of which is shown in Fig. 1, are most economical on large melts; Fig. 2 shows that a charge of 25 kg. melts at the rate of 0.83 kg. per min., while for a 100-kg. charge the melting rate is 1.59 kg. per min. in the same furnace. In many foundries, coke furnaces are used to pre-heat casting pots or for maintaining pots for die-casting shops prior to the transfer of molten metal. The furnace height should be arranged for making additions of coke conveniently.

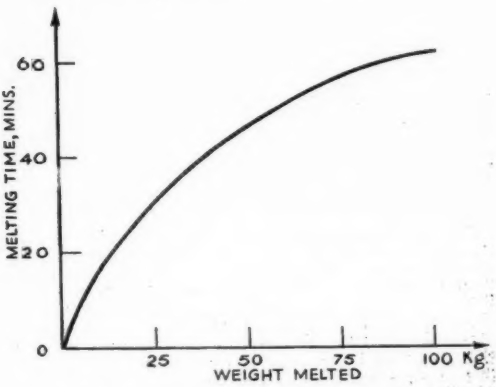

FIG. 2.—RELATION OF WEIGHT OF CHARGE TO MELTING TIME FOR A COKE-FIRED FURNACE.

Guide to Aluminium Founding II

FIG. 3.—OIL-FIRED CRUCIBLE FURNACE WITH POWER-OPERATED TILTING DEVICE.

Oil-fired Furnaces

Oil-fired crucible furnaces are quite popular, and in conjunction with gas-fired furnaces constitute the majority of those used in aluminium foundries.[3] Many of the subsequent remarks apply to both types of furnaces. The crucible should be mounted in the combustion zone of the furnace, so that no burnt gases escape around the edges of the pot. Sealing of the small gap between the crucible and the furnace wall with fireclay will ensure this. Such a measure is only an additional precaution, since the design should be such that the flames do not get near the top of the crucible. Care should be taken to shut the furnace off well below the required casting temperature, since overheating is harmful. No general limits can be quoted about this, but a few experiments soon yield the characteristics of any furnace type; this point should be noted if an automatic temperature-control device is contemplated. The melting rate of these furnaces depends on a number of factors; for 500-lb. capacity furnaces, it is about 8 to 10 lb. per min. and about 60 lb. of fuel oil are used per 100 lb. of metal melted.

Induction Furnaces.—From many viewpoints, induction melting furnaces offer most ideal conditions, since gas absorption cannot take place and a homogeneous melt is ensured.[3 4] The heating principle is based on that of a transformer, the primary winding being designed to carry a moderately-heavy current at normal mains frequency and voltage. The melting space is shaped so as to give an annular cavity at the base, this cavity being centred around a low-hysteresis core. The "ring," when full of molten metal, constitutes the secondary winding of the transformer. The necessity for the "ring" is a disadvantage, since it must be filled with molten metal before melting can commence, and must remain when the crucible is emptied. When changing the alloy, care has to be taken to empty the ring if there are appreciable differences in the compositions. At intervals the ring should be cleaned, since it tends to become choked with oxide. Power consumption for these furnaces is in the order of 550 kw.-hrs. per ton of metal. An example of an induction melting furnace, for the production of die castings, is shown in Fig. 4.

Other Furnaces.—Gas-fired furnaces are also widely employed; a large 1,200-lb. furnace has a consumption averaging 3.5 cub. ft. of gas per lb. of metal. Over the past few years, furnaces of the reverberatory type (Fig. 5) have been introduced with success for aluminium alloys. They are particularly useful where large quantities of metal are required and are frequently used for holding furnaces to supply metal for die casting. An account of such a furnace[5] claims that the oil consumption is about 4¼ galls. per 100 lb. melted, which at present means that the cost of melting is about 3d. per lb. The melting loss on alloy of the DTD.424 (AC.4) type is stated to average 3.6 per cent., and the melting rate 2¼ lb. per min. for a 10-cwt. charge.

FIG. 4.—INDUCTION MELTING FURNACE, BY BIRLEC, LIMITED, 150 LB. CAPACITY, USED FOR PRODUCING DIE CASTINGS.

Crucibles and Tools

Crucibles used for melting are usually made from graphite or silicon carbide mixtures, these being usually supplied glazed, a factor which is important for electric furnaces in the prevention of oxidation. Silicon-carbide crucibles give long life, but graphite crucibles are preferred by many on account of lower initial cost with satisfactory life. Cast-iron pots are favoured in some quarters on account of good strength. Pressed-steel pots are not recommended for aluminium because of excessive solution of iron in the molten metal. Even

FIG. 5.—SKLENAR OIL-FIRED REVERBERATORY FURNACE, 500-LB. CAPACITY.

cast-iron pots are not free from this trouble, and although a suitable coating wash will reduce the solvent tendency, cast-iron pots are not recommended for use where iron content of an alloy is important. A suitable wash for cast-iron pots consists of 5 lb. china clay, ¼ lb. sodium silicate to 1 gall. of water. French chalk may be used as an alternative to the china clay. This mixture should be used on all iron or steel tools required in the various stages of melting and casting. It is particularly important that these tools should be thoroughly cleaned and given a coating of the wash each day. The crucible should be heated to a red heat at the beginning of each day and raked free from all dross adhering to it. These minor details have an important influence on the cleanliness of the melts.

When commencing either with a new furnace or crucible, it should be thoroughly dried out before melting begins. The furnace should be started at a gentle heat and gradually brought up to full heat without a charge and maintained for a period. This may occupy a few hours for a 100-lb. furnace, up to several days for one melting a ton of metal. If the foundry has had no experience with this type of furnace, a small melt can be run down when the furnace is considered to be dry and cast into blocks. These, when machined, will show, by the presence of pinholes, if the furnace is still damp.

Temperature measurement can be made using a chromel-alumel couple, the end of which has been bared, attached to a pyrometer. Casting temperatures should be determined for each job and standardised. A periodic check of the pyrometer against a standard instrument is necessary and it is usual to employ a bare-wire couple for this purpose, the end being stripped of protective covering for about two inches so that a quick reading may be obtained. Chromel-alumel couples are normally used for checking also. The indicating instrument of the furnace pyrometer should be easily seen by the furnaceman and should read to the nearest 5 deg. C.

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AUTHOR'S CORRECTION

The Author has asked us to print several minor amendments to the first article in this series, published in the JOURNAL for October 20. Referring to Table I on page 494, it should be noted that there is now no material AC.11C, the aircraft specification DTD.361 being the only one applicable to the alloy treated to give the properties listed against this group. The properties quoted for AC.8 are those for castings in the solution heat-treated condition under the sub-group AC.8B. Furthermore, the tensile strength for AC.15 is 18 tons per sq. in., the same as for castings to DTD.131B and DTD.255. The alloy AC.6 is nominally 12 per cent. silicon.

With regard to Fig. 2, it should have been made clear that the amount of iron-bearing constituent is in excess of that normally present, the photograph having been taken from an area showing local segregation. High iron content results in brittleness and the loss of the ductility produced by modification.

British Cast Iron Research Association

Annual Report, 1948-49

(Extract)

The year under review, ending June 30, 1949, completed the first of a new five-year period which heralded a notable change in the status of the Association dealt with fully in the last annual report. As from the beginning of this period, by arrangements made with and through the Joint Iron Council, every firm engaged in ironfounding throughout the United Kingdom became entitled to membership by the simple formality of completing a membership application form. While no objection has been raised in any quarter in complying with this arrangement, it may be pointed out that the Department of Scientific and Industrial Research requires it because the member-firm thereby agrees to abide by the Articles of Association and provides the necessary assurance that it is a British firm, since membership is confined to companies whose capital is predominantly British. The membership of firms operating in the United Kingdom, but whose capital is not predominantly British, requires the prior consent of the Board of Trade, although in the case of firms employing British labour this is usually forthcoming. The whole of those foundries in the United Kingdom known to be engaged in the production of iron castings have since been circularised on two occasions and over 500 replies have been received to date, doubling the membership of the Association and bringing it for the first time to four figures.

Although by virtue of the above arrangements it is not essential for member-firms engaged in the production of iron castings to make additional financial contributions to the Association, they are in fact able to make such contributions should they, at their discretion, be willing to do so. This is encouraged by the Department of Scientific and Industrial Research, which treats such voluntary contributions as grant-earning. The total of such contributions for the year 1948-49 exceeds £2,500 and the Council record their deep appreciation and thanks to those firms which have assisted the Association's programme in this way. Every £1 so contributed at present enables £2 to be devoted to the Association's work.

Expansion

The effect of the new basis has been virtually to double the Association's income and to make possible plans for expansion. These are being dealt with respectively on a short-term and a long-term basis. On the short-term basis, plans have been made for the provision at headquarters of some single-storey buildings comprising a machine and instrument shop and mechanical-testing laboratory, together with staff cloakrooms and canteen, mainly to relieve existing deficiencies. Building began in February, 1949, and it is hoped will be completed this calender year. In addition, a considerable change has taken place at the Scottish laboratory. For many years premises for this laboratory have been rented from the Stirlingshire Education Authority at Falkirk, the lease of which was determined at Whitsuntide, 1949. The Scottish Committee arranged a number of meetings to consider the situation arising, and as a result, with the unanimous approval of the Committee, endorsed by the Council, it was decided to transfer the site of the laboratory to Glasgow. A suitable bay of about 5,000 sq. ft. area was obtained on the Blantyre Industrial Estate and the move has now been effected. It is anticipated that the capital costs of these short-term plans can be met out of income (and there is no other source from which they can be met) by June, 1950.

While the major enlargement of staff depends upon accommodation and equipment, the staff has been increased, and now exceeds eighty. Furthermore, an important development was approved by the Council at the close of the year under review and entrusted to a specially-appointed committee. This relates to the establishment of an advisory service in the form of an operational research team yet to be appointed. This team will be available, by invitation, to member-firms who seek to raise the operating efficiency of their foundries to the highest possible standards. Reports will be for the confidential information of the managements concerned, on any steps that may be needed to improve performance, whether in relation to quality, output, cost or the best use of manpower.

The long-term plan under consideration by the Council comprises the provision of further buildings at headquarters for laboratory work, for development and for work on fuels and furnaces. It is anticipated that this plan will permit the staff to be increased to a figure of the order of 160, to permit an ultimate organisation to exist consisting of a fully equipped and staffed intelligence department, development department and research department, the two last-mentioned departments being aided by a group of specialised laboratories, the services of which they would share in approximately equal proportions. This plan is based on the assumption that the Association will be able ultimately to reach an income of £100,000 per annum, the figure for the year under review being of the order of £80,000. It is evident that the change in the value of money has made the figure of £100.000 inadequate to meet all future requirements, and the ultimate income should be nearer £150,000.

Council and Committees

The annual general meeting was held in London on November 3, 1948, and Mr. P. H. Wilson, O.B.E., was unanimously and with acclamation elected president to succeed Dr. Harold Hartley, who was elected

an honorary member. As vice-presidents, Mr. P. A. Abernethy, Sir William Griffiths, Dr. J. E. Hurst, J.P., and Mr. F. Scopes were elected.

In order to facilitate election under the new arrangements, all members of council had tendered their resignations to the chairman and these were accepted in order to give the annual general meeting a free hand. In accordance with the arrangements with the Joint Iron Council, twelve nominations were made by that body and these gentlemen were duly elected. Of these, the members new to the Council were Mr. D. K. Barclay, Mr. W. J. Colton, Mr. C. Gresty, Mr. R. L. Handley, Mr. R. S. M. Jeffrey, Mr. R. K. Nicholson and Mr. G. R. Shotton. The remaining five were members of the previous Council: Mr. G. H. Johnson, Mr. G. T. Lunt, Mr. N. R. Rees. Mr. S. H. Russell and Mr. J. J. Sheehan. Mr. Kenneth Marshall, Mr. A. E. Peace, Mr. R. C. Shepherd, Mr. L. F. Wright were also elected to the Council, together with the following, who had previously served: Mr. C. C. Booth, Mr. V. Everard, J.P., Mr. H. Field. Mr. T. M. Herbert, Mr. T. Makenzon, M.B.E., Mr. A. E. Pearce and Mr. FitzHerbert Wright.

The Council, at its first meeting, elected Dr. J. E. Hurst as chairman and Mr. G. T. Lunt as hon. treasurer. The Council deplore the unexpected death of Mr. Lunt on January 4, 1949. Mr. Lunt had been wholeheartedly devoted to the interests of the Association as a member of council, various committees. including the Executive Committee, and for several years as hon. treasurer. No successor has yet been appointed to the position of hon. treasurer.

The Executive Committee has been replaced by a similarly constituted Advisory Committee, and the Council and Advisory Committee have each met five times. Considerable thought has been devoted to the Committee structure, so as to make it possible for all members who wish to do so to take part in Committee activities and permit the Association to make use of their energy, knowledge and enthusiasm. The research board was constituted from a group of members of Council mainly to supervise research policy, finance and priorities. The fundamental research programme is reviewed by the research board, together with a number of distinguished gentlemen who constitute the Fundamental Research Committee. That part of the research programme of direct and immediate value to the industry is reviewed by the Industrial Research Committee, which consists of the research board, together with the chairmen and research sub-committees which at present remain substantially unchanged:—Engineering castings, malleable castings, white and chilled castings, light castings (one for England and one for Scotland), fuels and furnaces, and sands and refractories. By an arrangement with the Joint Iron Council, the foundry-pig and refined-iron sub-committee has been reconstituted. The research board and its two committees have met eight times during the year and there have been fourteen meetings of sub-committees, panels and joint committees with other bodies. Mr. A. E. Peace was elected chairman of the research board and its two committees. The Development Committee was continued, Mr. J. J. Sheehan being re-elected chairman, and has met three times. The Information and Publications Committee, the name of which has been abbreviated to the Information Committee, has met on four occasions, under the chairmanship of Mr. T. M. Herbert, who was unanimously re-elected.

Research Department

The announcement of a practicable method of producing cast irons possessing a nodular graphite structure was made to members in February, 1948, and to the public in Papers to metallurgical institutions in this country and U.S.A. in March and April, 1948. The reaction in the industry was immediate and the work may be described without exaggeration as the metallurgical sensation of the year. American recognition, in particular, was prompt and generous. Lownie, of the Battelle Memorial Institute, in "Metals Review" for March, 1949, said that the work was "well planned and well directed," and that it "is generally regarded as a major contribution to the field of metallurgy and the product of carefully considered and well conducted research." In the discussion on the Research Manager's American Paper ("Transactions of the American Foundrymen's Society," Vol. 56, 1948), Col. A. I. Krynitsky, of the U.S. Bureau of Standards, said: "The author should be congratulated for his splendid work. The theoretical and practical importance of this most interesting and valuable Paper cannot be over-emphasised."

In the discussion on the two Papers mentioned, to the Iron and Steel Institute in London, May, 1948, and to the Philadelphia Conference of the American Foundrymen's Society early in June, the International Nickel Company and Mond Nickel Company disclosed that similar results were being obtained by the use of magnesium. A considerable amount of development work has, of course, taken place in a number of directions.

Work has also been continued upon the production of nodular graphite structure and a report has been submitted to the Fundamental Research Committee on this subject showing the similarities between the various processes for obtaining these structures. The production of these structures by alternative processes is also being pursued. In connection with graphite formation, work is proceeding upon the effect of small amounts of various elements on the structure of pure alloys and on the form of manganese sulphide in cast iron and the influence of inoculation on this.

Other Projects

The first part of the work on the ternary iron-carbon-phosphorus system has been completed and useful information has been obtained upon the mechanism of solidification of phosphoric materials and on the formation of "pseudo-binary" phosphide eutectic. The mechanism of graphite formation during the annealing of white cast iron for the production of

B.C.I.R.A. Annual Report, 1948-49

malleable iron is also being studied, with particular emphasis on the effect of rate of heating on nodule number. A Paper describing this work was presented at the Annual Conference of the Institute of British Foundrymen in June, 1949. The dilatometric technique for the determination of rate of graphitisation continues to be used in this connection.

The Fundamental Research Committee has approved a programme of work on slag-metal reactions and a preliminary report summarising all the existing information has been submitted to this Committee. The programme of work in this connection involves a study of the effect of melting furnace refractories and slags on the annealability of white cast iron and on the chilling tendency and fluidity of grey cast iron. Further work has been carried out on the testing of various proprietary graphitising ladle additions. The investigations on chemical analytical methods have covered the determination of magnesium in cast iron; the determination of carbon using solid samples in the combustion method; and work is continuing on the determination of very small amounts of sulphur in cast iron.

The investigation on spectrochemical methods for the analysis of cast iron has proceeded and attention has been concentrated upon the effect of atmosphere surrounding the electrical discharge and upon the mechanism of arc and spark discharge, although much work has been done on actual determinations and in investigational work arising therefrom.

An investigation has been begun on the fluidity of cast iron with special reference to the problem of fluidity of cast iron for the production of light castings. A preliminary report on this work has been issued. A satisfactory modification of the fluidity spiral has been worked out and is being applied to determine the effect of composition and temperature on fluidity. Work has continued upon the corrosion and erosion of cast-iron propellers and apparatus has been constructed particularly for studying cavitation erosion. This work is carried out in conjunction with the British Shipbuilding Research Association. Various corrosion problems arising in the course of the work of the development department have been investigated.

Mechanical Properties

In connection with the work on special mechanical properties of cast iron, stress-strain curves have been determined on ingot-mould materials at various temperatures. Considerable progress has been made in the investigation comparing the mechanical properties of ring sections with those of corresponding round test-bars. The mechanical properties of a number of cast irons have been determined at sub-zero temperatures. The influence of section size and shape on cast-iron beams is being studied. A number of members have co-operated in this investigation by supplying various materials. Work has continued upon the evaluation of the mechanical properties of nodular cast irons with particular reference to their fatigue characteristics. Data on the fatigue properties of cast iron continue to be obtained.

Further work has been carried out upon the resistance of cast iron to thermal shock and a preliminary report has been issued to the appropriate sub-committee. Apparatus has been constructed for the determination of hydrogen in cast iron by the vacuum-heating method. The results have indicated that grey cast iron behaves somewhat differently from steels when this method is applied. Plans have been made for the construction of a new vacuum fusion apparatus, using high-frequency heating.

Sands

Experimental work upon sands has continued with the study of expansion defects and the elimination of scabs, the use of urea and phenol formaldehydes for bonding and pitch powder as a substitute for coal dust. Work has also been carried out upon the volume of gases evolved on heating cores and on the use of dielectric heating for core baking. Work on the toxic properties of oil bonds is being carried out at Loughborough College, as part of the Association's programme. The work of the department is in charge of Mr. H. Morrogh as manager. The current programme is given as an appendix.

Development Department

During the year the department actively continued its work in dealing with problems received from members. No fewer than 1,297 problems were dealt with, 964 at headquarters (an increase of 69 over the previous year) and 333 in Scotland (an increase of 33). Major problems totalled 800, an increase of 121, the remainder, consisting of referee tests, check tests on members' own laboratories, etc., being treated on the basis of straightforward laboratory tests. It should be noted that about three-quarters of the increase in major problems was the result of inquiries from members who had joined the Association as a result of the new membership basis. The staff of the department have visited members' works in connection with specific problems whenever necessary and have spent between one-fifth and one-sixth of their valuable time on such work.

In addition to dealing with members' problems, a number of investigations appropriate to the work of the department have been pursued. Work has also continued upon the commercial production and uses of nodular cast iron in the foundries of member-firms, and a member of the staff of the department is engaged solely upon this work.

The investigational work of the department at present proceeding includes investigations on the cracking of light castings, coatings for foundry chaplets, welding of cast iron and shrinkage and feeding. A report upon the relationship between the carbon equivalent value, structure and strength of unalloyed grey cast iron appeared in the "Journal of Research and Development," Vol. 2, No. 11, March, 1949, and a Paper on the same subject was also presented to the Annual Conference of the American Foundrymen's Society as the official exchange Paper from the Institute of British Foundrymen. A number of small-scale investigations

have also been carried out in connection with specific problems submitted to the department and, in a number of cases, prototype castings have been produced in the Association's experimental melting shop for trial in members' works.

The department continues to follow closely the present position regarding raw materials for the foundry and in particular the variations occurring in the quality of foundry coke. The Association is represented by Mr. W. J. Driscoll on a panel of the British Coke Research Association which has been formed to consider the desirable properties of foundry coke. The number of balanced-blast cupolas installed is now 358, with an aggregate hourly output of 2,770 tons.

The staff of the department continue to participate actively in the work of committees of various technical and scientific organisations and research bodies and represents the Association on a Ministry of Labour and National Service (Factory Department) Sub-committee of the Joint Standing Committee on Conditions in Ironfoundries. The development work of the Association is in charge of Dr. H. T. Angus as manager, and Mr. W. B. Parkes as assistant manager.

Scottish Laboratories

Mr. A. N. Sumner began his duties as superintendent of the Scottish laboratory of the Association in succession to the late Mr. T. Tyrie, on December 1, 1948. Until Mr. Sumner's appointment, Mr. C. Ford, senior assistant, was responsible for the day-to-day work of the laboratory. In addition to the problems dealt with as given above, the actual tests and analyses carried out by the Scottish laboratories also increased by about 25 per cent.

During the year, as already stated, the lease of the Association's premises at Falkirk expired and the Scottish Committee approved the transfer of the laboratory to Blantyre Industrial Estate, Glasgow. During this transfer, which has now been made, the normal routine work of the laboratory has been carried out at headquarters. The new premises are larger and more convenient than those occupied at Falkirk, and it is proposed to increase the staff and equipment so that greater facilities will be available to Scottish ironfounders. The move to the new premises is being carried out by Mr. Sumner, and a date for the official opening will be announced in due course.

Intelligence Department and Library

During the year under review fifteen research reports were published in the "Journal of Research and Development," which completed its second volume in June, 1949. Consequent upon the large increase in membership, the Information Committee has carefully reconsidered the desirability of retaining the confidential status of the "Journal." It was finally decided that, in view of its present wide circulation, it was no longer practicable to issue the "Journal" as a confidential publication; and the Council has accepted the recommendation of the Information Committee that from August, 1949, the "Journal" be made available to non-members on a subscription basis or, alternatively, on exchange terms with scientific or technical organisations of suitable standing.

The "Bulletin" has appeared at regular intervals; an index to Volume 8 has been published and the binding of this volume has been undertaken for a number of members. Ten external reports, seven of which consist of Papers given by members of the Association's staff to external bodies, have been circulated to members. A large number (over 100) of translations of foreign Papers have been made available. All the German journals of interest to the foundry industry, which have re-commenced publication since the war, may now be obtained from the library.

Library loans and accessions of new works and pamphlets are given below:—*Library Loans:* Books, 444; periodicals, 2,709, and pamphlets, 984. *Library Accessions*: Books, 284; periodicals 28; and pamphlets, 561.

Over 400 inquiries (excluding library loans and other inquiries) were dealt with by the intelligence department during the year. Much useful work has been carried out by the library staff in bringing the library catalogue and index of references up to date and in compiling indexes to the "Journal" and "Bulletin." A large number of bibliographies is now available on various aspects of ironfounding and the metallurgy of cast iron. The most urgent library requirement at present is space. The collection of text-books and periodicals is increasing at a rapid rate and the available store space is already severely strained.

The fuel conference organised at Ashorne Hill in April, 1949, was highly successful and well attended by members, representatives of Government departments and delegates from organisations at home and abroad. The discussions and exchange of views following the presentation of Papers were particularly valuable. The Council has adopted the policy of holding two such conferences each year and the last conference, on "Foundry Sands," was held at the end of September, 1949, the conference centre again being taxed to capacity.

The Association accepted an invitation from the Department of Scientific and Industrial Research to take part in the 1949 Engineering and Marine Exhibition at Olympia. Among the exhibits was a short film in general terms on the cavitation erosion of cast-iron propellers, prepared in conjunction with the D.S.I.R. and indicating some of the work in progress in the laboratories at Alvechurch. A working model of the jet impact machine was also shown.

The intelligence department has played an advisory role in the preliminary arrangements for the metallurgical exhibition to be held in connection with the forthcoming Festival of Britain, 1951. Notices or references to the Association's work which have appeared in the technical and newspaper Press total 175 during the period under review. The work of the intelligence department is in charge of Mr. G. R. Woodward as manager.

B.C.I.R.A. Annual Report, 1948-49

Finance and Membership

The number of ordinary and trade members at September 1, 1949, was 1,031. The total income of the Association exceeded £80,000 and the whole of the difference between income and running expenditure has been absorbed by, or has been set aside to meet, commitments in connection with extensions referred to above. The Council have pleasure in reporting that as from October 1, 1948, a superannuation scheme has been put into operation for the staff and the Council accepted responsibility for payments under this scheme for both past service and future service. Mr. T. M. Herbert, Mr. A. E. Pearce and the director act as trustees for the scheme.

Relations with Other Bodies

The Association's headquarters at Bordesley Hall had a considerable number of visitors during the year. Between 40 and 50 overseas visitors came from 13 countries. The Council record with pleasure the award to the director of an honorary Doctorate by the University of Aachen, in October, 1948. Details were given in the "Bulletin" for January, 1949. Aachen is, of course, the home of the foundry institute well known all over the world, and built up by Prof. E. Piwowarsky, as an outstanding centre for research in the field of the cast metals.

D.S.I.R. Delegates

With the approval of the Council, the D.S.I.R. appointed two "visitors" to the Association under its scheme for such appointments to all research associations. The "visitors" keep in touch with the Association by periodical visits, as it has been found virtually impossible for the Advisory Council to do so on account of the greatly increased number of such associations. The "visitors" appointed were Prof. H. O'Neill, of University College, Swansea, and Mr. W. Barr, of Colvilles. Both visited headquarters in January and subsequently Mr. Barr visited the Scottish Laboratory. Later in the year, the newly-appointed secretary to the D.S.I.R., Sir Ben Lockspeiser, who succeeded Sir Edward Appleton, visited the Association and saw the work in progress.

SALES AND TECHNICAL CONGRESS

Last month Holman Bros., Limited, held a sales and technical congress at their works at Camborne. It was attended by 19 representatives of their overseas subsidiaries, branches and agencies from the following countries:—Australia, Canada, South Africa, West Africa, East Africa, New Zealand, South America, Holland, Norway, Sweden, Italy, India and Pakistan, Malaya, and Spain. There were also present 13 representatives of the home branches. The agenda covered a very wide variety of subjects concerning products, including also administration, publicity, design and development, application, market requirements and sales procedure. In addition to the daily conferences, evening discussions were also arranged at the delegates' hotel, where members of the organisation delivered papers on various applications of the firm's products.

Institute Elects New Members

(*Continued from page* 524.)

SECOND LIST

As Members

*J. E. Allcock, foundry manager, Guest Keen & Nettlefolds (S.W.), Limited, Gwmbran; S. G. W. Brown, foundry manager, S. H. Johnson & Company, Limited, London, E.15; G. R. Lewington, managing editor, "British Steelmaker"; R. Lewis, works manager and technical director, Newcast Foundries, Limited, Silverdale; G. Sain, chief engineer and general manager, The Nahan Foundry, Himachal Pradesh, India; W. D. Urwick, director and foundry manager, Bricefield, Limited, Maidenhead.

As Associate Members

M. H. Ellor, metallurgist, Sykes & Harrison's, Limited, Bangor; C. N. Goodenough, in charge of mechanised foundry equipment, Cardiff Foundry (1947), Limited, Cardiff; A. Gregory, metallurgist, Cardiff Foundry & Engineering Company, Limited, Cardiff; H. N. Maliphant, assistant metallurgist, R. Thomas & Baldwins, Limited, Swansea; E. C. M. Neale, senior foreman, mechanised foundry, W. A. Baker & Company, Limited, Newport, Mon; K. D. Rao, assistant foundry foreman, Richardson & Cruddas, India; J. R. Smith, technical assistant, C. & B. Smith, Limited, Wolverhampton.

As Associates (*over* 21)

R. England, charge-hand, machine foundry, Fowler & Holden (Grimsby), Limited, Grimsby; H. E. Ord, patternmaker, Head Wrightson & Company, Limited, Stockton-on-Tees; W. M. Sayer, apprentice, K. & L. Steelfounders & Engineers, Limited, Letchworth.

As Associates (*under* 21)

D. Morris, apprentice in foundrywork and metallurgy, K. & L. Steelfounders & Engineers, Limited, Letchworth; T. W. Reynolds, apprentice moulder, Newton Chambers & Company, Limited, Sheffield.

* Transferred.

ON page 519 of our last week's issue an error was made in printing Mr. Sheehan's comments relating to the Report of the Lake & Elliot Technical Committee. The sentence should read: "There was a slight concentration of the formaldehyde just as the cores came out of the baking oven, which was not very disagreeable and could be readily avoided, while from the castings themselves there was very much less disagreeable fume than the old dextrine combination, and the atmosphere was very much clearer."

Vitreous Enamelling Section

Furnace Atmospheres in Vitreous Enamelling*

By S. E. A. Ryder, B.Sc., F.R.I.C., and G. W. Culshaw, Ph.D., F.R.I.C.

It is known from experience that "scumming" is connected with conditions inside the muffle, in particular the infiltration of considerable amounts of products of combustion into the muffle. It is also common experience that some types of frit are more susceptible to the trouble than others.

Experience with town-gas-fired furnaces has shown that infiltration of flue gases sufficient to give 1 per cent. of carbon dioxide in the muffle atmosphere does not cause scumming with any frit, but if 3 per cent. is present, scumming will probably occur on zirconium or antimony enamels, but not on acid-resistant titanium enamel. It should be explained that when reference is made in this way to 3 per cent. of carbon dioxide in the muffle, it is not intended to suggest that the carbon dioxide is the cause of the scumming. The percentage of carbon dioxide present is used as a measure of the amount of flue gas entering the muffle, because it is the easiest flue-gas constituent to determine.

The necessity of maintaining a high degree of purity in the muffle atmosphere places severe limitations on the furnace designer and, no doubt, if enamel could be fused without loss of gloss in an atmosphere containing appreciable amounts of products of combustion, then considerably higher thermal efficiencies could be obtained together with savings on capital costs of the furnace. This applies particularly to town-gas-fired furnaces where the flue gases are quite free from particles of ash, or incompletely-burned fuel.

Cause of Scumming

Scumming is usually attributed to sulphur contained in the fuel, and one American authority has stated that as little as four parts per million of sulphur trioxide in the atmosphere is injurious, but the trouble is certainly not unknown with electric muffle fusing where no sulphur compounds can arise from the fuel. From experience it is reasonable to suppose that scumming is caused by a constituent of the flue gases not present to any great extent in air. These, of course, are oxides of sulphur, carbon dioxide and water vapour.

It was decided to examine the effect of these compounds individually by fusing enamelled plates in atmospheres of pure air to which varying amounts of contaminants were added.

Method of Investigation

The apparatus, illustrated in Fig. 1 and shown diagrammatically in Fig. 2, consists of an electrically-

FIG. 1.—GENERAL VIEW OF APPARATUS.

*Paper presented at the Annual Conference of the Institute of Vitreous Enamellers, in Birmingham, October, 1949.

Enamelling Furnace Atmospheres

heated laboratory muffle, internal dimensions 3¼ in. by 5¼ in. by 11 in., giving a cubic capacity of approximately ¼ cub. ft. Into the back of this was passed air at the rate of approximately 10 cub. ft. per hr., and known amounts of contaminants were added to the air stream at some distance before the muffle so as to ensure thorough mixing. This gas rate gave an average air change in the muffle of more than one per minute, and it was felt that under these conditions the muffle atmosphere would be almost identical with the stream passing into it, and analytical checks confirmed this, *e.g.*: (*a*) 0.74 per cent. by volume of sulphur dioxide was added to the air stream passing into the muffle and a gravimetric analysis of a sample drawn out of the muffle gave 0.75 per cent. sulphur dioxide, (*b*) a stream containing 6 per cent. of carbon dioxide was passed into the muffle, and Orsat analysis of the muffle atmosphere agreed with this. This air stream was filtered, dried and passed through a tower packed with "Carbest" to absorb any acid gases such as carbon dioxide or sulphur dioxide, and then metered by calibrated flow gauge before entering delivery tube to the furnace. The contaminating gases were purified, where necessary, metered by flow gauge, and passed into the air stream. The source of sulphur dioxide was a syphon of liquid sulphur dioxide, while the carbon dioxide was obtained from a cylinder of compressed gas. Sulphur trioxide was obtained by passing the mixture of air and sulphur dioxide through a tube packed with platinised asbestos and heated to 400 deg. C. A high proportion of the sulphur dioxide was oxidised, but no doubt a considerable amount dissociated again in the muffle at 830 deg. C.

Known amounts of moisture were added to the muffle by passing a subsidiary air stream through saturators maintained at constant temperature in a water bath.

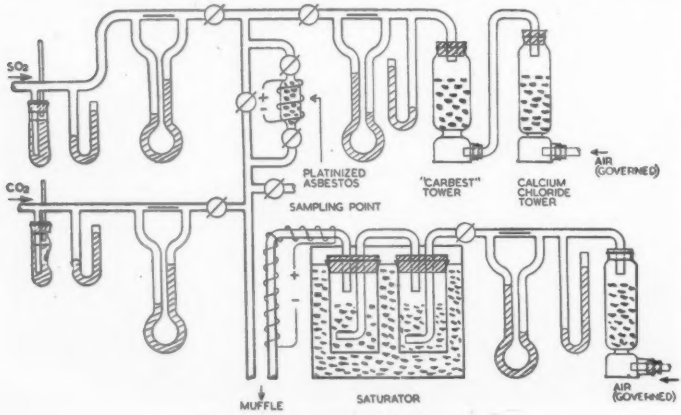

FIG. 2.—DIAGRAM OF APPARATUS.

The effect of the various contaminants on the fused enamel was determined by a Photo-volt gloss-meter. For each test run a number of plates were sprayed with the same batch of milled enamel and dried under identical conditions in pure air. At the commencement and end of each experimental run two plates were fired with pure air only passing into the muffle. The gloss-meter reading of the four plates gave good agreement and was given an arbitrary value of 100. The gloss of the enamel fired in contaminated atmospheres is reported as a percentage of the gloss reading obtained for the blank.

Three types of frit have been examined, *viz.*, an acid-resisting titanium frit, a high-opacity zirconium frit, and an antimony frit.

At each concentration of contaminant two plates were fused at the muffle, one after the other. On each of the plates five readings of gloss were observed by the gloss-meter and all the readings averaged. With this procedure reasonable agreement has been obtained between the individual plates of each pair, and also no difficulty has been experienced in reproducing the results.

Experimental Results

The results of adding various amounts of sulphur dioxide to the air are shown in Fig. 3 in which loss of gloss has been plotted against sulphur-dioxide concentration.

It was found that, on plates giving meter readings 10 per cent. lower than the readings obtained on the blanks, the loss of gloss was barely discernible by eye. Such loss of gloss would certainly not have been the cause for rejection of finished ware.

It will be seen that the titanium and zirconium frits gave similar reactions to sulphur dioxide, but the antimony frit was affected to a greater degree at the lower concentrations.

Fig. 4 shows the results obtained with air contaminated with SO_3/SO_2. Oxidation of some of the sulphur dioxide to sulphide trioxide has considerably increased the scumming effect on the titanium and zirconium enamels. In order to illustrate this increased effect in the case of zirconium frit, the results for sulphur-dioxide contamination and SO_3/SO_2 contamination are given in Fig. 5.

It is seen that 0.05 per cent. sulphur dioxide gave 9 per cent. loss of gloss, while oxidation to sulphur trioxide increased the loss of gloss to 13 per cent. The effect on the titanium frit was similar, but on the antimony frit, sulphur trioxide had no greater effect than sulphur dioxide. It is apparent from these results that oxides of sulphur do play a con-

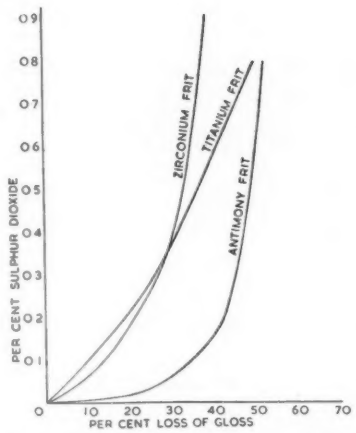

FIG. 3.—EFFECT OF FUSING IN SULPHUR-DIOXIDE ATMOSPHERE.

siderable part in the scumming of enamels during fusing.

The effect of carbon dioxide was next investigated. Plates sprayed with titanium, zirconium and antimony frits were fused in atmospheres containing varying amounts of carbon dioxide ranging from 1 to 20 per cent. and in no case was any loss of gloss experienced. For example, with antimony frit:—

(1) Fused in air ... ... gloss = 100
(2) Fused in air plus 20 per cent. CO_2 gloss = 101

The effect of the third major flue-gas constituent, water vapour, was then investigated. Various amounts of water vapour up to a maximum of 40 per cent. were used and all three frits were fused in these atmospheres, but in no case was any loss of gloss detectable. The following example was obtained with antimony frit:—

(1) Fused in air ... ... gloss = 100
(2) Fused in air plus 15 per cent. water vapour ... ... gloss = 100

It appears from these results that of the major flue-gas constituents, oxides of sulphur are the only ones which alone can cause scumming.

It was thought that, although carbon dioxide or water vapour alone would not cause scumming, yet either or both may increase the effect produced by sulphur compounds, when they are present together, as in flue gases. Varying amounts of carbon dioxide were added to an air stream containing known amounts of sulphur dioxide and also to a stream containing known amounts of sulphur trioxide, and in no case was the loss of gloss greater than would be expected from the presence of the sulphur oxide alone.

For example, a series of plates was sprayed with the zirconium frit, dried and fused as follows:—

(1) Fused in pure air ... ... gloss = 100
(2) Fused in air plus 0.16 per cent. SO_3 ... ... gloss = 79
(3) Fused in air plus 0.16 per cent. SO_3 plus 6.9 per cent. CO_2 ... ... gloss = 79

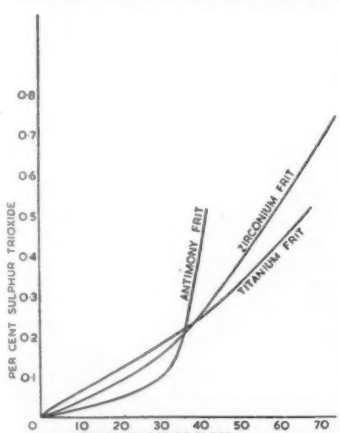

FIG. 4.—EFFECT OF FUSING IN ATMOSPHERE CONTAINING SULPHUR TRIOXIDE.

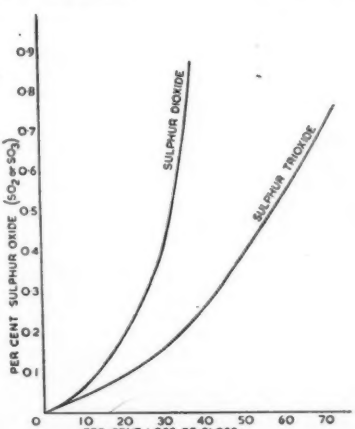

FIG. 5.—EFFECT OF SULPHUR-TRIOXIDE ATMOSPHERE ON ZIRCONIUM FRIT.

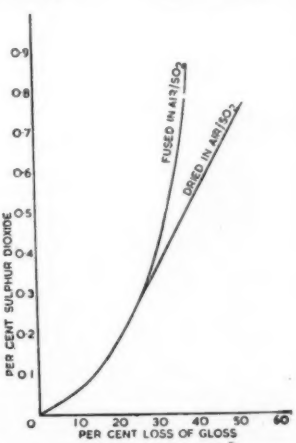

FIG. 6.—EFFECT OF SULPHUR DIOXIDE IN ATMOSPHERE DURING DRYING.

Enamelling Furnace Atmospheres

As usual, two plates, one after the other, were fused under each condition.

Each of the three frits was fused under the above conditions with similar results.

The effect of a combination of sulphur dioxide with water vapour in the muffle atmosphere has been investigated with all three frits, and in no case did the presence of water vapour increase the effect of the sulphur dioxide.

For example, with the zirconium frit:—

(1) Fused in pure air ... ... gloss = 100
(2) Fused in air plus 0.15 per cent. SO_2 gloss = 82
(3) Fused in air plus 0.15 per cent. SO_2 plus 12.7 per cent. water vapour gloss = 81

The effect of a combination of carbon dioxide and water vapour added to the muffle atmosphere was investigated in the case of all the frits and again no scumming could be produced.

For example, with antimony frit:—

(1) Fused in pure air ... ... gloss = 100
(2) Fused in air plus 20 per cent. CO_2 plus 37 per cent. water vapour gloss = 98

Combinations of carbon dioxide, water vapour and sulphur dioxide, and combinations of carbon dioxide, water vapour and sulphur trioxide were next tried with each of the frits.

In each case, the combination of the three constituents was found to cause no more loss of gloss than the corresponding amount of sulphur dioxide or sulphur trioxide alone in the atmosphere.

For example, with antimony frit:—

(1) Fused in pure air ... ... gloss = 100
(2) Fused in air plus 0.11 per cent. SO_2 ... ... gloss = 66
(3) Fused in air plus 0.11 per cent. SO_2 plus 4.6 per cent. CO_2 plus 11.6 per cent. water vapour ... gloss = 70

Consideration of Results

From the results presented it appears that the only constituents of flue gases responsible for scumming of enamels during fusing are the sulphur oxides. While the foregoing results clearly indicate that this is so, it is felt that more experimental work is needed to finalise the results, and there are a number of outstanding points requiring elucidation. If, however, further work confirms that the sulphur compounds are the sole source of scumming during fusing, this may be of value in furnace design. For instance, if sulphur compounds are eliminated from town gas, it would not be necessary to use muffles for fusing with this fuel; open furnaces could be used with consequent saving in capital cost and fuel. It is known that, for some years, one of the large gas undertakings in the Potteries has gone to great lengths to reduce the sulphur content of the gas it supplies to such a figure that pottery can be fired in gas-heated kilns without the use of sagars, where formerly these were essential.

If a supply of gas with a sufficiently-low sulphur content cannot be obtained from the local undertaking, would it be worth while to instal plant to treat the furnace fuel gas (for instance an active carbon-absorption plant) and so reduce the sulphur content?

It has been mentioned earlier that scumming has been known to occur occasionally in electric enamelling furnaces in which there can be no question of atmosphere contamination by products of combustion. One explanation of this has been that it is due to water vapour which is given off by the enamel and accumulates in the furnace atmosphere. The results obtained with the laboratory apparatus described here do not support this view.

Enamel may, of course, be exposed to sulphur contamination apart from the fusing stage in the furnace. One likely source is during the drying operation. Do sulphur compounds in the dryer atmosphere have any effect on the finished ware? In order to check this point, plates sprayed with zirconium frit were dried in atmospheres containing varying amounts of sulphur dioxide and sulphur trioxide and subsequently fused in a pure air atmosphere.

The results for sulphur dioxide are shown in the graph in Fig. 6. For comparison purposes the results of fusing the same frit in similar atmospheres have been included.

It is seen from this graph that sulphur dioxide in the dryer atmospheres has as much effect as in the muffle atmosphere, while preliminary results indicate that the same is true in the case of sulphur trioxide. It is possible, therefore, that when scumming trouble has been experienced with electric furnaces, the source of this trouble may not be in the furnace at all. Few enamellers pay much attention to the chemical composition of their dryer atmospheres and, in many cases, products of combustion of gas are used directly for drying.

It has been mentioned that it is not considered that the results presented in this Paper are complete. There are several reasons for this. Under the laboratory conditions, a minimum sulphur-oxide concentration in the region of 0.05 per cent. by volume was required to produce significant scumming effects. This is very much greater than could possibly be obtained in a town-gas-fired muffle with a sulphur content in the gas in the region of 20 grains per 100 cub. ft., although it may be attained in an oil-fired muffle. It has not been possible to find a reason for this.

Although experiments have been carried out with the principal constituents of products of combustion, there are also present oxides of nitrogen. They are present in very much smaller amounts than the other constituents, but it is felt that it would be worth while investigating their effect when opportunity permits.

It has been shown that contamination of dryer atmospheres is as serious a matter as contamination of muffle atmospheres, and it would be advantageous to investigate whether the effects of contamination at these two stages are additive.

All the plates processed in these experiments were fired at 830 deg. C. for 3½ min., and all the plates used in the dryer-atmosphere experiments were dried at 150

deg. C. for 6 min., and this Paper, therefore, does not present any information as to the effect of length of time of exposure to contamination, either during fusing or drying. It is felt that this information would be valuable.

Only one standard milling has been used for each frit in these experiments, but it would be interesting to know whether milling formula has any significance. For instance, would a more alkaline slip tend to absorb more sulphur oxide during drying than one with a lower *p*H value?

In conclusion it is suggested that there is room for much more investigation into the effects of the atmospheres to which enamelling frits are exposed during the various stages of application. For many years the Institute has considered carrying out or sponsoring research work in the interests of the industry, but has been hampered by lack of funds which has prevented the introduction of any ambitious research programme. An investigation along the lines indicated in this Paper would not require elaborate or expensive apparatus, and would not be beyond the resources of the Institute, but would be fruitful in supplying useful information to the industry.

Acknowledgment is made for help received from colleagues in carrying out the experimental work and to the directors of Stoves, Limited, for permission to publish the information.

DISCUSSION

The discussion on this Paper was initiated by the chairman, MR. C. P. STONE, who found it of particular interest to learn that sulphur was proved to be one of the main causes of trouble due to scumming. He commented on the fact that small-scale apparatus was now becoming available for removing water-vapour and other gases from furnace atmospheres.

DR. MARTIN asked if there was any delay before the enamelled test-pieces were measured for scumming, as he had found delayed scumming to be the more serious type. The Author explained that when the experiments had been carried out (last May), no particular delay had been observed before taking readings, but more-recent tests had indicated that humid atmospheres caused delayed scumming of the type mentioned by Dr. Martin. This was out of line with the earlier experiments.

MR. BIDDULPH considered that scumming was affected, also, by drying procedure and time in various atmospheres particularly humid ones; the results were additive, and that explained "Monday-morning" troubles.

MR. DUNNING, referring to the purity of town's gas, quoted two grains per 100 cub. ft. for the SO_2 content of gas purified on one up-to-date hematite plant as compared with 20 grains quoted by the Author. There were, he added, small plants available using nickel sub-oxide which could be used for producing "on-site" gas of high purity.

DR. NICKLEWSKI reported that American natural-gas-fired furnaces, using low-sulphur fuel, did not produce scumming, but that in the London works with which he was associated much scumming was experienced on foggy, humid days.

MR. RYDER, dealing with the question of humidity, mentioned that at a works in America, where a chloride plant was available for drying the furnace gases, the results considered in relation to scumming were inconclusive.

The CHAIRMAN mentioned the apparent anomaly with regard to open-flame firing which, he said, was practised in Birmingham with complete absence of scumming on both antimony- and tin-bearing enamels, yet the same enamel in a muffle furnace gave rise to scumming. He thought the explanation lay in the concentration of water-vapour at the top of the muffle chamber.

Other Experiences

Several speakers confirmed that scumming was experienced even when steam drying was used in conjunction with electrically-heated muffles for drying and firing enamels. Finally, MR. LAITHWAITE summed up his experiences in the following terms:—(1) With furnaces using Mond gas for firing, containing 150 grains sulphur dioxide per 100 cub. ft., scumming was a very serious problem but he believed that under perfectly dry conditions sulphur was relatively harmless; (2) sulphur in all materials and atmospheres was additive and a maximum value had been established for the total sulphur above which scumming trouble was experienced; (3) there were other causes of scumming besides sulphur; (4) of three distinct effects—ordinary scumming, de-vitrification scumming and surface-film scumming—only sulphur scumming caused delayed appearance of the defect; it was, he thought, due to the exposure of an alkali sulphide, formed on the surface of the enamel, to a humid atmosphere; (5) black-enamel has an "unholy" aptitude for showing up scumming.

MR. RYDER, replying, said that further experiments would be made using chemically dry materials and gases. He considered that the three types of scumming quoted might be differences only in degree.

After members had heartily endorsed a vote of thanks to the Author, the meeting was adjourned.

Vitreous Enamels. Published by Borax Consolidated, Limited, Regis House, King William Street, London, E.C.4.

This 64-page, well-illustrated brochure is a miniature text-book on vitreous enamelling. Stripped of all verbiage, the subject is taken through six chapters from "Historical" to "Recent Developments." Between, there are chapters covering the raw materials, their preparation, including frit making and milling. There is a chapter on the two metal bases—sheet steel and cast iron. Chapter III tells of the actual vitreous enamelling process, and is followed by one on defects. Then, penultimately, the properties of frits are detailed. The book proper closes with titania- and zirconia-opacified frits and low-temperature enamels, but, rightly, there have been included a bibliography, an appendix (the selection of commercial frit batches), and an index. The brochure is a really worth-while addition to technical trade literature on vitreous enamelling and will, it is reasonably certain to assert, receive an excellent reception from the trade.

I.V.E. Conference Discussion

Light Castings for Vitreous Enamelling*

By H. McNair

When this Paper was presented at the Annual Conference of the Institute of Vitreous Enamellers at Birmingham, it was followed by a short discussion from which the following are extracts:—

DR. NIKLEWSKI asked how much of the trouble due to blistering of enamels was due to hydrogen absorbed in the melt, either from wet coke or other materials. He considered that rusty scrap was the main offender. A second question concerned design—was there any standard increase of radii in the corners of box-like castings as the over-all dimensions increased? He had found that, unless these radii were increased with the size of a component, trouble with cracking during enamelling was experienced.

MR. MCNAIR, replying, said that in connection with hydrogen or other dissolved gases he would not be prepared to go further than the statement in his Paper. He said then that the incidence of trouble from this source had to be related to the section; a thin section could hold a fair amount of gas without giving rise to blistering, whereas a boss or increased section in the same iron would give defects when enamelled. Rusty scrap was a primary source of hydrogen absorption, and should be avoided. As regards the second point, he agreed with Dr. Niklewski, but could not quote any definite standards, each case had to be separately assessed.

MR. R. W. BEATTY described the Paper as a good one but would have liked a less dogmatic attitude to be taken; instead of "thou shalt not . . ." he preferred a positive approach towards making castings which were good for enamelling irrespective of whether or not they were good-looking. He contended that more attention should be given to graphite structure in an attempt to explain some of the anomalies which had been revealed in practical enamelling, and asked if any enamellability tests had been carried out on the new spherulitic-graphite cast iron.

MR. MCNAIR replied that it was important to establish and keep to good standard practice and specifications for producing iron castings for enamelling. As regards graphite structure, he repeated his assertion that coarse-graphite iron brought trouble with enamelling and that chilling or other means of graphite-size control should be resorted to with bosses and the like.

MR. BENTON mentioned that the ratios of the lengths of the arms of a frame-type casting was an important

(*Concluded at the foot of column two.*)

Low-temperature Enamels

It is apparent from a study of recently-published research reports that there is a tendency both in America and in this country towards the development and use of low-temperature vitreous enamels. Several enamels for steel have been tried, some of the titanium type and the others with a zircon base, as top coats, firing below 800 deg. C. Ground coats for nickel-dipped steel are available for use in the 700 to 750 deg. C. range. A low-opacity finish, primarily for architectural work, and for applying direct to steel, contains antimony.

A large potential field is open for very low-temperature enamels, particularly for aluminium and its alloys. Many of these are lead-containing, but one leadless composition for firing at 550 deg. C. is reported to be very satisfactory. Some of these very-low-temperature enamels are extremely resistant to thermal shock and aluminium alloys so coated can subsequently be hardened by quench treatment. Hardness and resistance to abrasion are usually less than for enamels applied to steel and acid- and alkali-resistance are lowered. The use of lead-containing enamels is, of course, confined to applications which do not involve contact with foodstuffs.

Nevertheless, although commercial possibilities of the low-temperature groups are still somewhat limited, the enamels have good adhesion and better resistance to thermal shock, heat, and mechanical damage than stoved paints and should thus find numerous applications, despite the substantially increased cost. For the future, it may well be necessary to consider vitreous-enamelled aluminium as a direct competitor with enamelled iron and steel.

(*Continued from previous column.*)

factor in design. Where there was a wide ratio, the casting was difficult to make and to enamel.

MR. J. GARDOM said that the Author advocated the use of coal dust in the moulding sand for producing castings for enamelling whereas, with a view to improving conditions in foundries, he favoured the elimination of coal dust. Similarly, with facing sand, generous use of which Mr. McNair had reported as giving the best results in a particular experiment, Mr. Gardom asked why not use all facing sand or "system" sand? The trouble with "ruts" on castings the speaker attributed to variation in grain size of the sand. Finally, with regard to iron to coke ratios, he thought that ten to one was very ambitious under today's conditions; it was better not to try to be too economical.

Replying to the last speaker, MR. MCNAIR asked for the various sections of his Paper to be viewed in proper perspective and for the amount of detail to be considered in relation to time at his disposal—he had been able to deal only with general aspects. In his remarks regarding the use of coal dust and procedures to be followed he had endeavoured to put forward views which would be of use to the average foundryman.

Notes from the Branches

London Branch—Slough Section

There was an attendance of 45 at the opening meeting of the 1949-50 session for the Slough Section (London Branch) of the Institute of British Foundrymen, which was held on October 18, in the lecture theatre of High Duty Alloys, Limited. In a brief inaugural address, the President, Mr. R. Blandy, said that an interesting programme had been arranged which he urged members to take full advantage of, and at the same time, to encourage the introduction of newcomers to the Section. He was followed by Mr. R. B. Templeton, immediate past-president of the Institute, who presented a film, "The Manufacture of a Cast Crankshaft," which dealt in a comprehensive fashion with all phases of the production of a large cast-iron crankshaft made at Qualcast (Ealing Park), Limited. A notable feature of the film was the method of production—the shaft being moulded by an assembly of cores and cast vertically. Mr. Templeton then showed a series of slides, dealing generally with the modes of manufacture of various types of cast crankshaft, illustrating particularly the methods of moulding and pouring. A description was also given of the methods of testing, particularly the fatigue test used to meet the requirements of Lloyd's Register of Shipping.

In an interesting discussion which followed, the main question dealt with was whether the cast crankshaft could compete successfully with the forged one. Here, Mr. Templeton said that the production of large single-cast crankshaft and small numbers of the lighter types was more economic than forged ones, provided that strict foundry control was maintained to eliminate or reduce possible defects to a minimum. As regards mass production, it was thought that the cast crankshaft would still prove a more economic proposition, but the main factors against its adoption, as yet, were first, the large capital required to lay down the necessary mechanised foundry, and secondly (and perhaps the most decisive), the inevitable inertia in the adoption of new ideas either of processes or materials. Mr. Templeton was congratulated during the discussion on the excellence of his presentation, an official vote of thanks being finally proposed by Mr. Logan.

East Midlands

The opening meeting of the East Midlands branch of the Institute of British Foundrymen was preceded by a visit by 130 members to the blast-furnace plant of the Renishaw Iron Company, Limited; a most interesting tour being arranged by Mr. J. F. Stanier, managing director. At the conclusion of the visit, members were entertained at tea, following which the Branch-President, Mr. C. A. Payne, presented his Presidential Address.

At the conclusion of this visit, a very hearty vote of thanks was accorded to the directors of the company, to Mr. Stanier, and his staff, in particular, for arrangements made for the interest and enjoyment of the members. The evening ended with entertainment.

The Managerial Jewel

A policy of nationalisation is forcing up taxation and manufacturing costs, and the nationalised industries are turning out to be nothing more or less than private monopolies controlled by the Minister in power at the moment, who of necessity must be swayed by political requirements in forming his opinions on policy—a state of affairs which would put any private enterprise into bankruptcy in a very short while, and a state of affairs which destroys initiative by denying incentive to the successful man who has a flair for getting things done, said Mr. J. E. V. Jobson, chairman of Qualcast, Limited, Derby, in his statement presented at last week's annual meeting of the company. If we cannot make available the prizes in industry to the young men who will have to take over in the future, is it not reasonable to suppose that we shall not have their services when we need them?

Last year, Mr. Jobson continued, I took the liberty of pointing out to you that I myself received only £8 a week net for my commercial activities. This year I will show you another facet of the managerial jewel—the companies with which I am connected in a managerial or directorial capacity during their last financial year are assessed for taxation of £1,164,969, and yet I personally have paid in taxation during the same period 22s. 2¼d. in the £, or more than the whole of my income from all sources. Mr. Jobson then asks: "Where is the incentive for the young men to try to reach the top when they are treated like this?"

Foremen's Mutual Benefit Society

Visit to Fairbairn Lawson Combe Barbour Limited

Over fifty works foremen went round the Leeds works of Fairbairn Lawson Combe Barbour, Limited, on October 24, on a visit arranged by the Foremen's Mutual Benefit Society. The two-hour tour of inspection began at 7 p.m., when the visitors were welcomed by Mr. W. R. Dawson (secretary) and Mr. G. W. Crompton (works manager). The night-shift was at work, and though there was no melt proceeding in the mechanised foundry, moulds were being made and the layout was clear. In the machine shop interest was concentrated on the special-purpose Holroyd six-spindle borer, which simultaneously machines six ball-race-fit holes in flyer rails; on the pair of 5 in. Wickman chucking automatics turning out ball-race housings, and the Newall jig-borer, which is isolated in a temperature-controlled room of its own.

Less familiar to the visitors, but quite as interesting, were the textile machines which they saw at work—the hosts make the full range of machines for processing of jute, flax, hemp and hard fibres—a controlled-draft spinning frame, and Autocoyl roll-former, a roving frame, a heavy gill spinner and a 3-ply twine laying machine. The tour finished with a supper in the foremen's canteen and a general discussion of the problems of textile engineering rounded off an enjoyable evening.

News in Brief

GUEST KEEN & BALDWINS, LIMITED, has announced a £100,000 scheme for the reorganisation of the Ivor Works foundry at Dowlais, near Merthyr Tydfil.

LAST MONDAY, Mr. F. D. Harper, of Stone-Wallwork, Limited, flew to Hungary in order to carry out the installation of a 10-ton turn-over-draw moulding machine.

IN 2½ YEARS a suggestions scheme at Newton Chambers & Company, Limited, Thorncliffe, near Sheffield, has produced 3,401 suggestions and £850 has been paid for 979 ideas adopted.

PLANS HAVE BEEN DRAWN UP for the building of a new foundry at Holditch Road, Newcastle, Staffs, for J. T. Price & Company (Brass & Aluminium Founders), Limited.

THE ENGINEER BUYERS & REPRESENTATIVES ASSOCIATION, LIMITED, London and Home Counties Branch, held its second dinner-dance at Frascati's Restaurant, Oxford Street, London, W.1, on October 14.

BORAX & CHEMICALS, LIMITED, 229, High Holborn, London, W.C.1, has revised its prices for borax and boric acid. The commercial granular 99.5 per cent. grade is now £36 for borax and £64 10s. for boric acid.

J. COLLIS & SONS, LIMITED, Regent Square, Gray's Inn Road, London, W.C.1, have just concluded an agreement with the Lake Shore Engineering Company, of Michigan, U.S.A., to manufacture and sell each other's products in each other's countries.

THE SOUTH MELTING SHOP of the Appleby-Frodingham branch of the United Steel Companies, Limited, recently achieved a record weekly output of 6,232 tons of ingots. This is an increase of 358 tons on the previous best which was recorded last July.

THE CHAIRMAN, Mr. E. Bruce Ball (Glenfield & Kennedy, Limited), and the vice-chairman, Mr. J. M. Storey (Dewrance & Company, Limited), were re-elected to those offices at the annual general meeting of the British Valve Manufacturers' Association on October 18. The meeting was held at the offices of Newman, Hender & Company, Limited, Woodchester, Glos, and before the meeting members toured the works.

IN VIEW OF THE GREAT DEMAND for tickets for both the Autumn courses on industrial law by Mr. Harry Samuels, Barrister at Law, the Industrial Welfare Society have arranged a further course to be given by Mr. Samuels on Tuesdays, January 10, 17, 24, and 31, at the Society's headquarters at 48, Bryanston Square, W.1. Application for tickets—£1 1s. (members), £1 10s. (non-members)—should be made to the secretary.

A LIAISON COMMITTEE of industrialists from Wales and Northern Ireland is to be set up by the Council of the Industrial Association of Wales and Monmouthshire "to promote inter-trading and goodwill." This development is the result of a recent visit to Northern Ireland by members of the Association when they inspected the new industries comparable with the types which have been established in Wales during the past 10 years. Arrangements are now being made for leading members of the Ulster Industries Development Association to make a similar tour of Wales.

£3,000 Scholarship

A gift of £3,000 by Mrs. James S. Greig to found a scholarship in memory of her husband was intimated to the governors of Dundee Institute of Art and Technology on October 25. Mr. Greig, a consulting engineer, died eight years ago. The scholarship will be open to students of the Technical College who have attended for at least two sessions an evening course leading to the national certificate in mechanical or electrical engineering, and who wish to enter a full-time day course for a higher national degree and subsequently to serve a student apprenticeship with an industrial firm.

What is a Kibble?

Recently, we were asked by a prominent manufacturer of foundry plant for a definition of "Kibble." Investigation has revealed that it is a local (Cumberland) unit of measurement and the screens used in the preparation of iron ores for the malleable trade are:—

60 Kibble—material passing through a ½-in. dia. hole.
70 Kibble—material passing through a ½-in. dia. hole.
80 Kibble—material passing through a $\frac{1}{16}$-in. square hole.

As, to the best of our knowledge, no work of reference gives this information, we print it for the benefit of posterity.

Obituary

MR. ADAM BUCHANAN ALLISON, who recently retired from the position of works manager of the Shotts Iron Company, Limited, died suddenly on October 20. He was 70.

MR. JAMES OLIVER SCOTT, who died on Friday, was managing director of Alder & Mackay, Limited, gas-meter manufacturers and brassfounders, of Edinburgh. He was also a director of Vanda Meters, Limited, Nelson, Lancs.

MR. W. H. SMITH, director and co-founder of the Foundry & Engineering Company (West Bromwich), Limited, died recently after a long period of ill-health. Mr. Smith who was 63, had been a member of the Institute of British Foundrymen since 1928 and for many years took a very active part in lectures and discussions. He will be best remembered for the large part he played in introducing to the foundry industry the new very widely used vertical continuous system of core drying.

Wills

BOOTH, W. H., of W. H. Booth, iron and brass founders, of Rotherham £35,164

PENZER, JOHN, for many years Swansea area representative of W. A. Baker & Company, Limited, ironfounders, of Newport, Mon £356

PERCY, A. E., chairman of Dan'ks, of Netherton, Limited, boilermakers, etc., the Renong Tin Dredging Company, Limited, British Castors, Limited, Birmingham, H. Marlow, Limited, bedstead manufacturers, of Dudley, Worcs, and S. F. Turner, Limited, grate manufacturers, etc., of Dudley, and a director of Hill & Smith, Limited, structural engineers, etc., of Brierley Hill, Staffs, and Hudson & Wright, Limited, seamless-tube manufacturers, of Birmingham ... £137,532

Company Results

(Figures for previous year in brackets.)

PARSONS MARINE STEAM TURBINE COMPANY—Consolidated trading profit, £109,705 (£106,597); sundry revenue, £32,220 (£23,859); to research and development expenditure, £8,973 (£9,230); directors' remuneration, £15,844 (£12,133); depreciation, £24,793 (£22,794); tax, £50,225 (£64,910); balance, £42,090 (£20,989); brought in, £50,919 (£51,718); final dividend of 9½%, making 12½% (same); grant to scholarship fund, £2,500 (same); forward, £68,721.

LAKE & ELLIOT—Trading profit for the year to July 31, £194,225 (£158,774); interest, £18 (£195); to depreciation, £16,370 (£11,732); off tools, equipment, etc., £3,967 (£4,453); pensions, £5,951 (£6,227); taxation, £88,600 (£70,607); deferred repairs and improvements, £34,750 (£36,500); doubtful debts, £1,500 (nil); auditors, £500 (same); net profit, £42,605 (£28,950); dividend of 20% (same); reserve for enhanced replacements costs, £12,564 (£10,732); forward, £96,299 (£75,418).

HENRY BERRY & COMPANY—Trading profit for the year to August 31, after directors' remuneration, etc., £56,374 (£48,184); transfer fees, £4 (£9); to depreciation, £8,430 (£8,434); directors' fees, £537 (£683) (aggregate amount of directors' other emoluments £8,251); taxation, £27,000 (£23,234); employees' gratuities, nil (£80); net profit, £20,411 (£15,662); dividend of 25% on increased capital (dividend of 20% and jubilee bonus of 5%); general reserve, £4,000 (£3,000); forward, £17,261 (£17,080).

T. M. BIRKETT & SONS—Consolidated trading profits for the year to July 31, £93,220 (£139,986); other sundry income, £614 (£549); to directors' remuneration, £5,960 (£7,616); audit, £365 (same); depreciation, £9,263 (£8,555); taxation, £46,208 (£88,435); net profit, £32,038 (£35,564); brought in, £54,019 (£40,905); 1947-48 directors' fees, £1,250 (£1,000); available, £84,807 (£75,469); to general reserve, £10.000 (nil); dividend of 30% (same); forward, £53,357, including parent £30,510 and subsidiary £22,847.

THOMAS BLACKBURN & SONS—Trading profit to June 30, £135,751 (£114,205); to directors' fees, £1,600 (some); director's pension, £300 (same); interest, etc., £772 (£3,172); superannuation, £4,052 (£3,426); depreciation, £10,417 (£8,846); profit, £118,610 (£96,861); to income tax, £47,500; profits tax, £15.000 (taxation £53,000); deferred repairs, nil (£3,000); plant replacement reserve, £10,000 (same); products development reserve, £10,000 (nil); general reserve, £12,000 (£10,000); dividend of 10% (same); forward, £32,881 (£17,901).

PETER BROTHERHOOD—Trading balance for the year ended March 31, £310,187 (£235,798); to directors' remuneration, £27,483 (£25,628); pension to former director, £1,550 (same); depreciation, £53,627 (£33,778); tax, £127,000 (£99.325); balance, £100,527 (£75,517); brought in, £159,741 (£150.685); to tax for previous year, £8,050. (nil); written off drawings and patterns, nil (£12,364); assets replacement reserve, nil (£50,000); general reserve, £28.500 (£10,000); contingencies reserve, £15,000 (nil); final dividend of 12%, making 20% (same); forward, £166.977.

PREMIER METAL COMPANY OF SOUTH AFRICA—Working profit, including profits on joint ventures and sundry revenue, £125.717 (£82,173); to selling charges, £18,246 (£15,629); administration, £15,372 (£16,231); finance and executive charges, £3,530 (£3.438); directors' fees, £1.050 (£1,067); net profit, £87.519 (£45,806); other income, nil (£42,260); provisions for taxation, £27,041 (£11,712); ordinary dividend of 12½% (same) and bonus of 6¼% (nil); preference dividend, £5.500 (£1,767); dividend equalisation account, nil (£25.000); written off premium paid on loan and share capital in Robertson Gold Mines, £15,000 (£23.199); investment in Sodium Chemicals, £3.999 (nil); forward, £24,361 (£21,429).

LEEDS FIRECLAY COMPANY—Trading profit of the company and its subsidiaries for the year to June 30, £70.422 (£84,403); investment income, £1.973 (£2.812); other income, nil (£2,564); to depreciation, £14,462 (£14.314); kiln repairs and renewals, £12,436 (£12,219); superannuation scheme, £1.465 (nil); debenture interest, £8,104 (same); directors' emoluments, £6,920 (£7,388); audit, £593 (£598); taxation (less overprovision 1948 £8.812), £64 (£4,629); net group profit, £28.351 (£41.827); brought in, £44.880 (£38.353 including £7.178 reduction in undistributed profits of subsidiary companies relating to previous years); ordinary dividend, nil (6%); dividend on preferred ordinary shares of 6% (8%), £16,500 (£22,000); taxation reserve, £10,000 (same); balance forward, parent company, £46,731.

Personal

MR. F. H. BROOKE has resigned from the board of the Leeds Fireclay Company, Limited.

MR. R. HOWARD has been appointed chief technical engineer of the railway division of British Timken, Limited.

MR. OLIVER W. HAYES has joined the staff of the National Research Corporation, Cambridge, Massachusetts, as the corporation's patent counsel.

LORD RIVERDALE, chairman of Arthur Balfour & Company, Limited, steel and tool manufacturers, of Sheffield, and LADY RIVERDALE, celebrated their golden wedding recently.

MR. J. PRESTON, until recently foundry superintendent of Hadfields (Australia), Limited, Sydney, New South Wales, is now visiting this country, accompanied by his wife.

MR. G. GORDON JACKSON, managing director of the Engineering Centre, Limited, 351, Sauchiehall Street, Glasgow, C.2, is to visit Canada in the New Year with the object of promoting sales of the products of supporters of the "Centre."

Company News

The paragraphs below have been extracted from statements circulated to shareholders, speeches made at annual meetings, and other announcements.

Lake & Elliot, Limited, foundrymen, etc., of Braintree, Essex:—Production in all departments has been at a high level and the total output has been greater than that achieved in the preceding record year. For 50 years the company's products have been chiefly associated with the motor industry. While still maintaining its unrivalled position in that sphere, the scope of its sales has been broadened to such a degree that at present its products are reaching almost every industry. Both in direct and indirect export there has been a steady increase in sales, and during the year executives have visited many countries to promote further sales. The order-book position is still satisfactory.

John I. Thornycroft & Company, Limited (SIR JOHN E. THORNYCROFT):—Turnover from the Southampton section of the organisation for the four years 1945-46 to 1948-49 has been approximately £15,750,000, and the balance from trading brought to the company's profit and loss account for this period has been only £633,000, which represents a very small margin on the capital employed. Unless the company is successful in obtaining additional new work contracts, or substantial new repair contracts, there may be a very marked falling-off in the turnover in 1950-51.

Baldwins (Holdings), Limited (LT.-COL. J. B. NEILSON):—The iron and steel industry continues to show an increase in production, but we have yet to see the full effect of the revaluation of the £ sterling. The Bill to nationalise the iron and steel industry is still before Parliament. In my opinion the provisions will not benefit those employed in the industry, the stockholders, or the country.

Imports and Exports of Iron and Steel

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in September. Figures for the same month in 1947 and 1948 are given for purposes of comparison.

Total Exports of Iron and Steel.

Destination.	Month ended September 30.		
	1947.	1948.	1949.
	Tons.	Tons.	Tons.
Channel Islands	453	992	975
Gibraltar	568	227	102
Malta and Gozo	230	692	264
Cyprus	350	332	292
British West Africa	3,251	4,099	5,839
Union of South Africa	11,747	11,310	7,415
Northern Rhodesia	372	1,481	1,725
Southern Rhodesia	437	4,176	3,606
British East Africa	3,092	7,339	7,140
Mauritius	175	1,749	798
Bahrain, Kuwait, Qatar and Trucial Oman	730	1,306	1,440
India	13,608*	5,870	5,621
Pakistan		1,627	1,792
Malaya	5,423	4,482	5,976
Ceylon	1,542	1,336	3,204
North Borneo	1,184	23	346
Hongkong	2,090	3,248	2,014
Australia	2,680	7,486	20,609
New Zealand	3,433	6,868	11,266
Canada	1,413	3,030	4,482
Bermuda	14	83	85
British West Indies	1,585	4,495	5,371
British Guiana	167	328	499
Anglo-Egyptian Sudan	215	842	1,267
Other British countries	554	1,373	1,284
Irish Republic	4,390	5,259	5,804
Russia	39	2,447	85
Finland	4,915	5,247	6,432
Sweden	5,067	7,361	4,828
Norway	4,524	5,618	4,107
Iceland	1,574	420	616
Denmark	7,614	7,820	6,828
Poland	32	175	31
Germany	16	57	9
Netherlands	5,864	6,797	9,073
Belgium	733	787	535
France	1,551	1,344	2,593
Switzerland	1,289	718	336
Portugal	1,313	1,608	1,958
Spain	421	676	751
Italy	695	185	281
Hungary	72	119	40
Czechoslovakia	2,268	106	1
Greece	1,627	621	161
Turkey	1,833	5,124	1,161
Dutch East Indies	1,866	2,322	1,646
Dutch W. India Islands	1,058	544	1,088
Belgian Congo	66	105	215
French W. and Eq. Africa	30	10	4
Portuguese East Africa	391	376	376
Canary Islands	122	625	186
Syria	474	87	147
Lebanon	460	1,696	919
Palestine (Israel)	2,219	134	1,741
Egypt	1,908	3,089	3,238
Morocco	31	15	469
Iraq	3,605	2,039	2,621
Iran	3,425	3,951	14,447
Burma	5,211	772	457
Siam (Thailand)	123	228	612
China	8,459	312	109
U.S.A.	223	2,810	453
Cuba	150	57	40
Colombia	811	105	277
Venezuela	4,329	6,838	2,709
Ecuador	260	30	213
Peru	276	69	651
Chile	321	203	339
Brazil	1,990	1,826	1,733
Uruguay	1,544	473	507
Argentine	11,541	11,560	6,011
Other foreign countries	2,999	1,499	3,211
Total	155,542	169,058	183,941

* Figures for 1947 relate to British India.

Total Imports of Iron and Steel.

From	Month ended September 30.		
	1947.	1948.	1949.
	Tons.	Tons.	Tons.
Australia	1	—	10
Canada	10,461	5,427	4,080
Other British countries and Irish Republic	794	1,264	878
Sweden	1,217	1,265	1,387
Norway	2,084	4,065	1,548
Germany	—	756	1,637
Netherlands	2,709	5,841	7,121
Belgium	7,840	30,741	13,882
Luxemburg	3,146	1,237	9,350
France	84	2,643	19,640
U.S.A.	15,647	4,718	35,820
Other foreign countries	17	510	580
Total	44,000	58,467	95,933
Iron ore and concentrates—			
Manganiferous	4,000	—	4,750
Other sorts	600,378	738,954	854,474
Iron and steel scrap and waste, fit only for the recovery of metal	36,209	95,155	203,384

Exports of Iron and Steel by Product.

Product.	Month ended September 30.		
	1947.	1948.	1949.
	Tons.	Tons.	Tons.
Pig-iron	1,501	95	1,192
Ferro-alloys, etc.—			
Ferro-tungsten	149	26	56
Spiegeleisen, ferro-manganese	24	84	603
All other descriptions	91	62	15
Ingots, blooms, billets, and slabs	50	194	275
Iron bars and rods	565	604	715
Sheet and tinplate bars, wire rods	168	486	403
Bright steel bars	2,249	1,717	1,588
Other steel bars and rods	10,243	10,186	15,369
Special steel	1,281	1,336	1,099
Angles, shapes, and sections	6,147	8,453	10,057
Castings and forgings	420	352	788
Girders, beams, joists, and pillars	2,400	1,725	3,265
Hoop and strip	3,153	3,871	4,454
Iron plate	139	1,207	1,233
Steel plate, ⅛ in. thick and over	9,740	11,258	19,486
Do., under ⅛ in. thick	5,230	9,852	8,046
Galvanised sheets	8,985	10,694	7,059
Tinplates	14,221	15,966	11,295
Tinned sheets	845	417	240
Terneplates	20	—	41
Decorated tinplates	215	224	—
Other coated plates	472	190	461
Cast-iron pipes, up to 6-in. dia.	5,409	5,948	5,679
Do., over 6-in. dia.	3,335	3,836	6,881
Wrought-iron tubes	20,054	19,890	23,754
Radiators, central-heating boilers	319	228	230
Railway material	11,960	20,358	12,692
Wire	2,990	4,021	5,309
Cable and rope	2,045	2,095	2,893
Netting, fencing, and mesh	1,387	1,465	1,445
Other wire manufactures	644	1,164	1,306
Nails, tacks, studs, etc.	843	817	403
Rivets and washers	819	770	601
Wood screws	273	228	250
Bolts, nuts, and metal screws	1,734	1,869	2,076
Stoves, grates, etc. (excl. gas)	481	1,020	702
Do., gas	127	260	217
Sanitary cisterns	97	113	239
Baths, sinks, etc.	258	662	962
Fencing material	237	125	476
Anchors, etc.	908	511	791
Chains, etc.	696	618	695
Springs	400	761	590
Hollow-ware	5,329	6,937	8,356
All other manufactures*	26,891	16,363	19,564
Total	155,542	169,058	183,941

* Figures for 1949 are not completely comparable with those for previous years.

STANTON-DALE

REFINED PIG IRON

Designed to meet the demands of high quality castings, which are, strength, machineability, and resistance to wear.

All these can be secured by using Stanton-Dale Refined Pig Iron in your cupolas.

The above illustration shows a group of castings made by Messrs. Goodbrand & Co. Ltd., Stalybridge, Cheshire.

PROMPT DELIVERY

THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Raw Material Markets

Iron and Steel

Between present production and consumption of pig-iron approximate equilibrium has been achieved. Steel-plant requirements are well covered and some of the light foundries have been able slightly to augment their stocks of high-phosphorus iron. There is also a steady demand for low- and medium-phosphorus and hematite grades to sustain the high scale of activity in the engineering establishments. Consequently, apart from a few small parcels of refined grades no export licences are being issued for pig-iron at present.

The backward swing of the pendulum is most apparent in the market for steel semis. Even in normal circumstances, the exceptionally heavy imports from Belgium, Luxemburg, and France during the summer months would have sufficed to overtake the requirements of the principal consumers in this country. But there has also been a sharp shrinkage in the demand owing to the decline of activity in the re-rolling industry. Many of the mills are now working below capacity, orders are scarce, and there is rather a glut of billets, slabs, blooms, etc., which is expected to be reflected in a substantial cut in the imports from the Continent.

It is a new experience for constructional engineers to be able to issue specifications for sections, joists, etc., with the assurance of fairly prompt delivery. On the other hand, there is not the slightest relaxation of the pressure for steel plates and sheets. Once again the complaint is heard that period allocations are far in excess of the maximum capacity of the mills, and there is a rush to secure deliveries within the prescribed time limits.

Non-ferrous Metals

The whole non-ferrous metal industry in this country has been a good deal heartened by the announcement that trading in tin on the London Metal Exchange will begin again on November 15. All traders hope that the change to a free market will be successful, for upon this may depend the extension of such facilities to copper, zinc, and lead. Unfortunately, the change-over from bulk purchasing to controlled private enterprise in tin has been delayed too long and the market re-opens in a period of over-supply, with heavy stocks in the United Kingdom and abroad. Moreover, next year promises to achieve a considerable excess of production over consumption and, in these circumstances, it is not surprising that consideration has recently been given by the Tin Study Group to the possibility of an international arrangement for the control of output. But weeks, if not months, must elapse before these talks can be brought to finality and, in the meantime, the market will have opened and prices will be finding a new level. Even to suggest a figure at which initial dealings will take place is almost impossible, but the general expectation is that the level will be a long way below £750.

The continuation of widespread labour troubles in the United States does not appear to have affected business circles, for Wall Street has been very firm and price movements on the National Commodity Exchange have been upwards. Zinc is particularly firm and the quotation on the open market has moved up to 9½ cents per lb., as a result of which the Ministry of Supply has advanced its selling limit by £2 to £83 10s. per ton. Copper, too, has looked firm and there have been renewed rumours of an advance to 18 cents or beyond. Undoubtedly consumption is at a high level and October seems likely to return an even bigger tonnage than September.

Scrap prices in Britain are firmer by a small margin, but the advance is hardly likely to go far, for the Government continues to offer for sale by tender considerable quantities of eminently usable material. For the most part this comprises brass scrap such as Q.F. cases and S.A.A. cases, but there is also a fair amount of fuse scrap of good quality. In the United States the price of copper scrap has advanced from 14 cents to 14.25 cents per lb., and this further strengthens the belief that the virgin copper quotation will rise to 18 cents quite soon.

British Standards Institution

The monthly information sheet of the British Standards Institution for September lists, under "New Standards," B.S. 1490:1949, Aluminium and aluminium-alloy ingots and castings for general engineering purposes (7s. 6d.), and B.S. 3A.4:1949, Test-pieces and test methods for aircraft metallic materials (2s.). Under "Revised Standards" there is B.S. 186:1949, Cast-iron and enamelled cast-iron steam-jacketed pans for the chemical and allied industries (2s. 6d.).

Under "Future Publications," there are B.S. 1121, Part 12: 1949, Methods for the analysis of iron and steel—silicon in acid-resisting high-silicon iron (1s.); B.S. 1121, Part 13: 1949, Methods for the analysis of iron and steel—chromium in iron and steel (1s.); B.S. 1121, Part 14: 1949, Methods for the analysis of iron and steel—copper in carbon and low-alloy steels (1s.); B.S. 1575: 1949, Cast-iron pipe flanges and flanged fittings, class 125, for the petroleum industry (7s. 6d.); and B.S. 1576: 1949, Cast-iron pipe flanges and flanged fittings, class 250, for the petroleum industry (7s. 6d.). Among "New Work Started," there are listed vitreous-enamelled steel reflectors for electric lighting (open dispersive type) (revision B.S. 232); clothing for protection against flame; and cast-iron flanged pipes and special castings for use therewith. The following draft standards have been circulated for comment:—CK5633, Determination of chromium in ferro-chromium, and CK5843, Electrode boilers for water heating and steam generation, riveted, fusion welded, and cast iron.